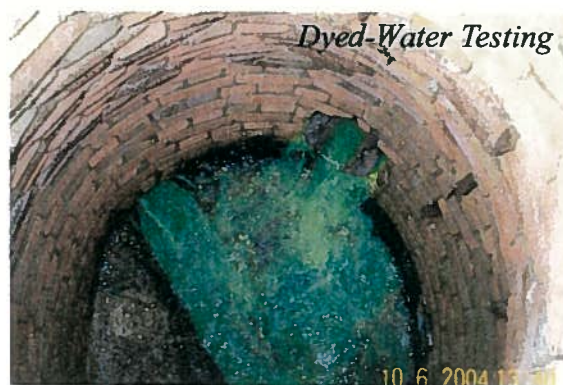


Sanitary Sewer Evaluation Mission Hills Selected Sewers for Johnson County Wastewater



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March 7, 2005

Stuart Lord, P.E.
Johnson County Wastewater
7311 W. 130th Street
Suite 100
Overland Park, KS 66213


Subject: Mission Hills Selected Sewers SSES Final Report
GBA Project No. 10496.00

Dear Stuart:

Enclosed are ten (10) copies of the final report for the subject project. The cooperation of JCW, the City of Kansas City, Missouri, the City of Mission Hills, Kansas and the residents of Mission Hills was vital to its completion. This report outlines the work completed and the steps remaining to rehabilitate the sewers in the project area.

If we can be of any assistance in completing the rehabilitation or final investigations let us know. Thank you again for the opportunity to serve Johnson County Wastewater.

Respectfully submitted,
George Butler Associates, Inc


Gary S. Beck, P.E.
Project Manager


Kayla Manning, E.I.T.
Project Engineer

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Report

CHAPTER 1 SUMMARY

A. INTRODUCTION

Johnson County Wastewater contracted George Butler Associates, Inc. to conduct a Sanitary Sewer System Evaluation of sewers owned by Kansas City, Missouri that are located within the City of Mission Hills. The project is intended to identify system defects that require repair.

The study area includes thirty-four (34) line segments and associated tributary properties located within the City of Mission Hills, Kansas. The line segments represent those currently owned and maintained by the City of Kansas City, Missouri (KCMO). However, excluded from this project is the main interceptor line owned by KCMO that follows Mission Drive thru the City of Mission Hills. The study area is shown in Figure 1.

A pipe and manhole inspection project for all of the City of Mission Hills was completed by The Larkin Group in 2001. Repairs to the manholes and pipes not included in this project were designed by GBA in 2002, and construction is complete. Sources of storm water identified on private property during previous building inspections completed by GBA were recommended for removal, and with few exceptions, are known to have been re-routed to the storm system. This project is intended to address the part of the sanitary sewer system owned and maintained by the City of Kansas City within the City of Mission Hills using previous inspection information where available, and additional inspection work necessary, as described further in this report.

B. PURPOSE AND SCOPE

The purpose of this project is as follows:

- Reduce wet weather capacity problems.
- Identify Inflow and Infiltration (I/I) sources. (Inflow is surface rainwater entering the system. Infiltration is groundwater entering the system. Both sources increase flows and overload the sanitary system during rainfall events.)
- Identify needed sanitary sewer main line and manhole structural repairs.

The following tasks were completed to achieve the goals listed above:

1. Manhole Inspections and Line Lamping

There are thirty-two (32) manholes in the system. These manholes were inspected in 2001 as part of a study completed by The Larkin Group. In order to review the

recommendations for manhole repairs, ten (10) internal manhole and lamping inspections were completed and compared to 2001 inspection results obtained in the 2001 Larkin SSES study.

2. Review Television Inspection Tapes

Twenty-nine (29) segments were reviewed from television inspection tapes produced by JCW collection system staff in December 2002. Four (4) segments were not included in the television inspection tapes GBA reviewed. One of these segments was lamped for defects and recommendations made based on the length seen. Another line was not accessible due to a locked gate, but the upstream manhole was previously flow monitored and no defects were noted at that time (the downstream manhole is located across State Line Road outside of the study area). The other two line segments appear to be abandoned.

3. Smoke Testing

Smoke testing was completed on all thirty-four (34) segments to determine approximate locations where storm water is entering the system.

4. Building Inspections

Building inspections were attempted for sixty-seven (67) buildings and completed for fifty-six (56) buildings. External inspections were completed when the resident was not home, except where access was not available.

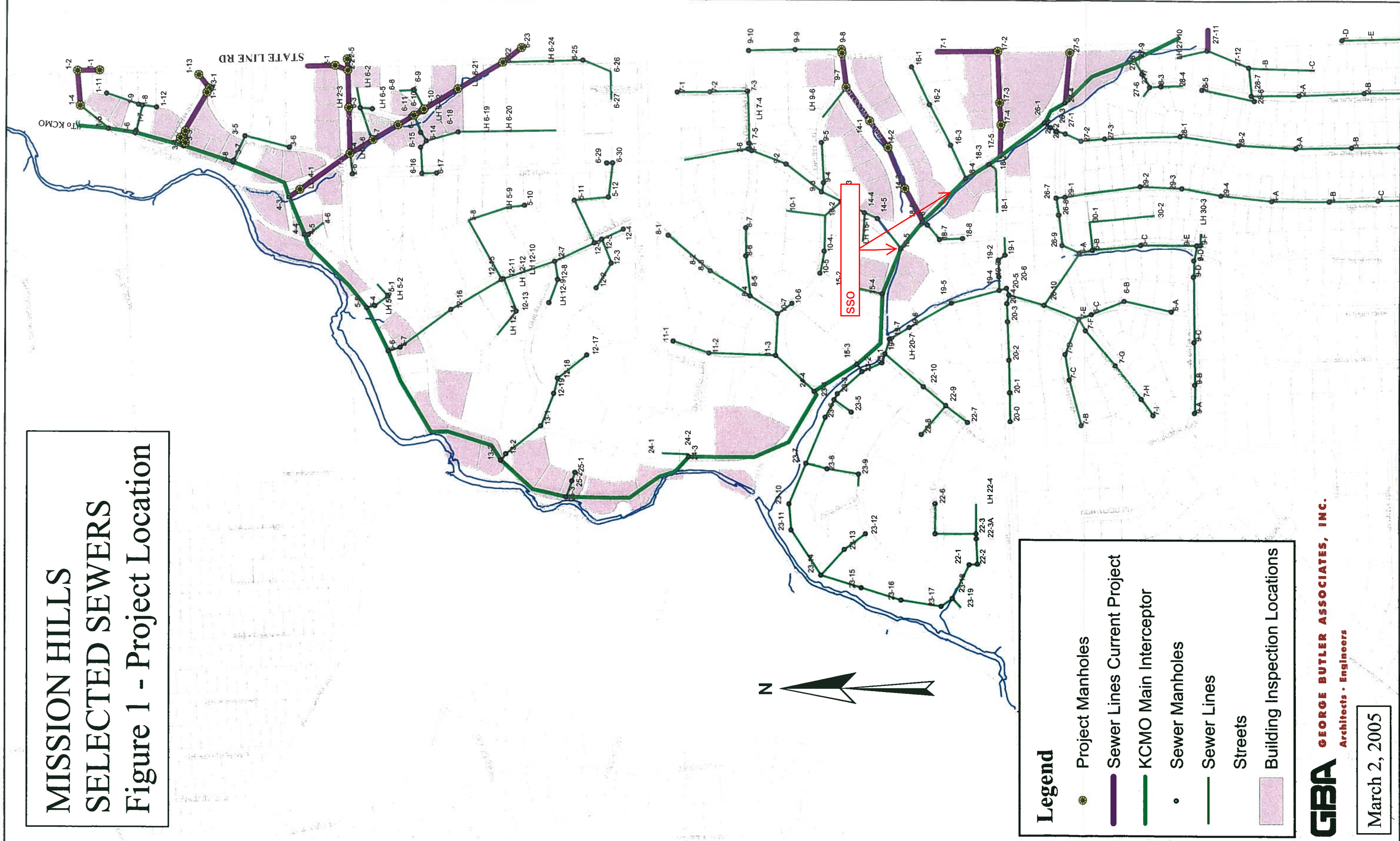
5. Dyed-Water Testing

Dyed-water testing was attempted for 203 sources including fifteen (15) public sources identified during smoke testing and 188 sources identified during building inspections.

6. System Plan and Recommendations

A system plan with recommendations was developed and is presented in this report.

**MISSION HILLS
SELECTED SEWERS
Figure 1 - Project Location**



CHAPTER 2

FIELD INSPECTIONS

A. MANHOLE INSPECTION AND LINE LAMPING

Manhole inspections are completed to gather information on manhole structure condition, pipe condition as far as visible, and invert elevation and pipe size information for use in determining system capacity. All manholes in a project are inspected, if found, since the manholes are the most visible part of the sanitary sewer system and can provide valuable information about the system.

Manhole inspection ratings are useful in selecting manholes for repair. During a manhole inspection all components of a manhole are observed and any evidence of non-sanitary flow is given a rating of one, two, or three. Similarly all defects are given a severity rating of one, two or three and a density code between of one, two, three, or four. The defects are assigned by component and categorized as broken, corroded, or a root intrusion. Flow and defect ratings are used to determine manholes to recommend for repair. Ratings of one are considered minor and not recommended for repair, but indicate the beginning of problems which should be monitored for additional deterioration in the future. Ratings of two or three are considered moderate to severe and are recommended for rehabilitation. If the condition of the manhole is so severe that immediate repair is necessary, the manhole is reported to the field supervisor who then notifies the client and an emergency repair can be made.

Manhole inspections for the 32 manholes in the study area were previously completed by The Larkin Group in 2001 as part of an inspection project covering all of the City of Mission Hills. To establish a comfort level in utilizing the Larkin data to make manhole recommendations for this report, ten (10) manholes were re-inspected and lamped to compare the inspection results previously completed by Larkin.

GBA inspectors typically recorded higher flow ratings and more structural defects than The Larkin Group.

The ten (10) manholes re-inspected by GBA contained multiple moderate to severe defects and are highly recommended for repair. Consistent between the different inspections is the types of defects found. A table listing defective manhole components and general costs to repair the component are included in Appendix B-1. Since other factors are involved in the cost of manhole rehabilitation, such as surface restoration, start-up costs, and different rehabilitation methods, it is recommended that all manholes be evaluated by an experienced designer to determine the best approach for each manhole and the overall system.

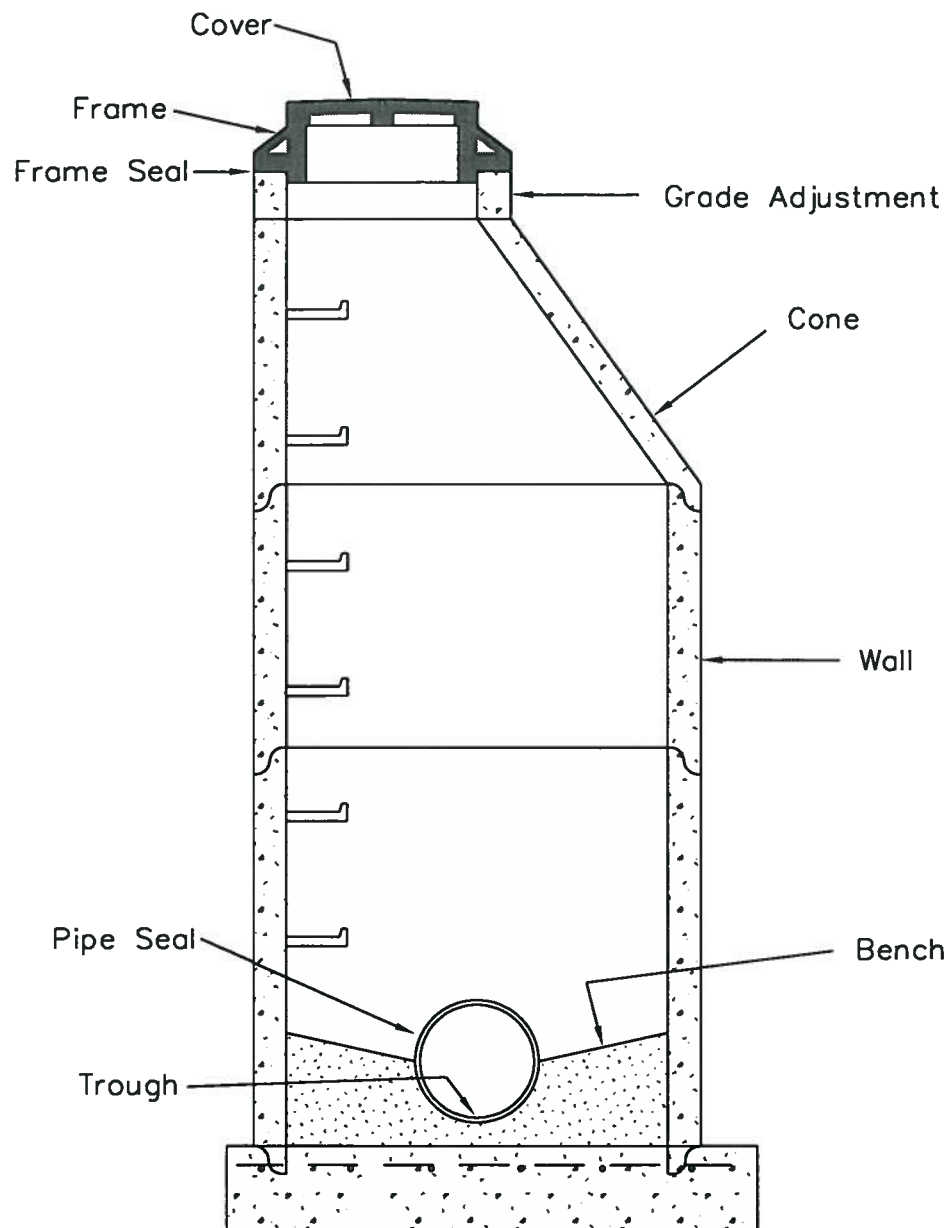
Based on the GBA inspections and the remaining Larkin inspections, a projected repair schedule was developed for the thirty-two (32) manholes. The preliminary manhole repair schedule is included in Appendix B-1. All manholes recommended for repair should be re-visited to develop the most appropriate overall rehabilitation plan for each structure.

All manholes inspected by GBA were found to need some type of repair. The most common defects involved vented manhole covers, frame seal defects and heavy infiltration from brick manhole walls. Typical locations of manhole I/I sources are shown in Figure 2. Actual observed defects are presented in Figure 3. Results for the sample ten (10) manhole inspections can be found in Table 1 and Table 2. All manhole recommendations can be found in the Manhole Rehabilitation Schedule in Appendix B-1.

Four manholes will need complete inspection to obtain elevation information and finish rehabilitation recommendations. Manhole 17-1 was buried and will require being raised to grade and inspected before additional recommendations can be made. Two additional manholes were found during television inspection and recommended for rehabilitation based on visible defects but require inspection to complete recommendations. Manhole 6-22 was replaced after the 2001 inspection, so the current condition is unknown.

Additionally, GBA is recommending four (4) new manholes be added to the system to assist with maintenance. New manholes are to replace lamp holes located at the upstream end of a segment, to keep segments at 400 feet in length or less, or provide access at locations where flow direction or slope changes occur

Selected Sewers
Mission Hills, Kansas



Manhole Inspection Areas

TYPICAL MANHOLE
I/I SOURCE LOCATIONS

FIGURE 2

PHOTOGRAPHIC RECORD SHEET

FIGURE 3

GEORGE BUTLER ASSOCIATES, INC.
ENGINEERS & ARCHITECTS

CLIENT: Johnson County Wastewater
PROJECT: Mission Hills Selected Sewers



Manhole: 9-7

Defect: Pipe Seal

Description: Severe pipe seal defect. Heavy dyed-water entered around pipe during main line dyed water test upstream.



Manhole: 14-3

Defect: Grade Adjustment

Description: Severe grade adjustment defect. This manhole is located in a grassy median a few feet from a storm ditch.

Table 1 - Manhole I/I Sources

Source	Larkin I/I Flow Ratings				GBA I/I Flow Ratings			
	1	2	3	Total	1	2	3	Total
Cover	1	0	0	1	7	2	0	9
Frame	1	0	0	1	2	1	0	3
Frame Seal	10	0	0	10	3	3	3	9
Grade Adjustment	6	0	0	6	3	3	1	7
Cone	3	1	1	5	2	4	2	8
Wall	7	2	1	10	0	5	3	8
Bench	4	1	0	5	1	1	0	2
Trough	1	0	0	1	1	0	0	1
Total	33	4	2	39	19	19	9	47
Notes: (1) Results are for 10 manholes inspected for verification of Larkin SSES study 2001.								

Table 2 - Manhole Structural Component Defects

Manhole Component	Larkin			GBA		
	Broken	Corrosion	Total Defects	Broken	Corrosion	Total Defects
Cover	0	0	0	0	0	0
Frame	0	2	2	1	2	3
Frame Seal	1	1	2	5	0	5
Grade Adjustment	0	0	0	6	3	9
Cone	1	0	1	4	1	5
Wall	0	0	0	5	0	5
Bench	1	0	1	2	1	3
Trough	0	0	0	4	1	5
Total			6			35

Notes:

(1) Results are for 10 manholes inspected for verification of Larkin SSES study 2001.

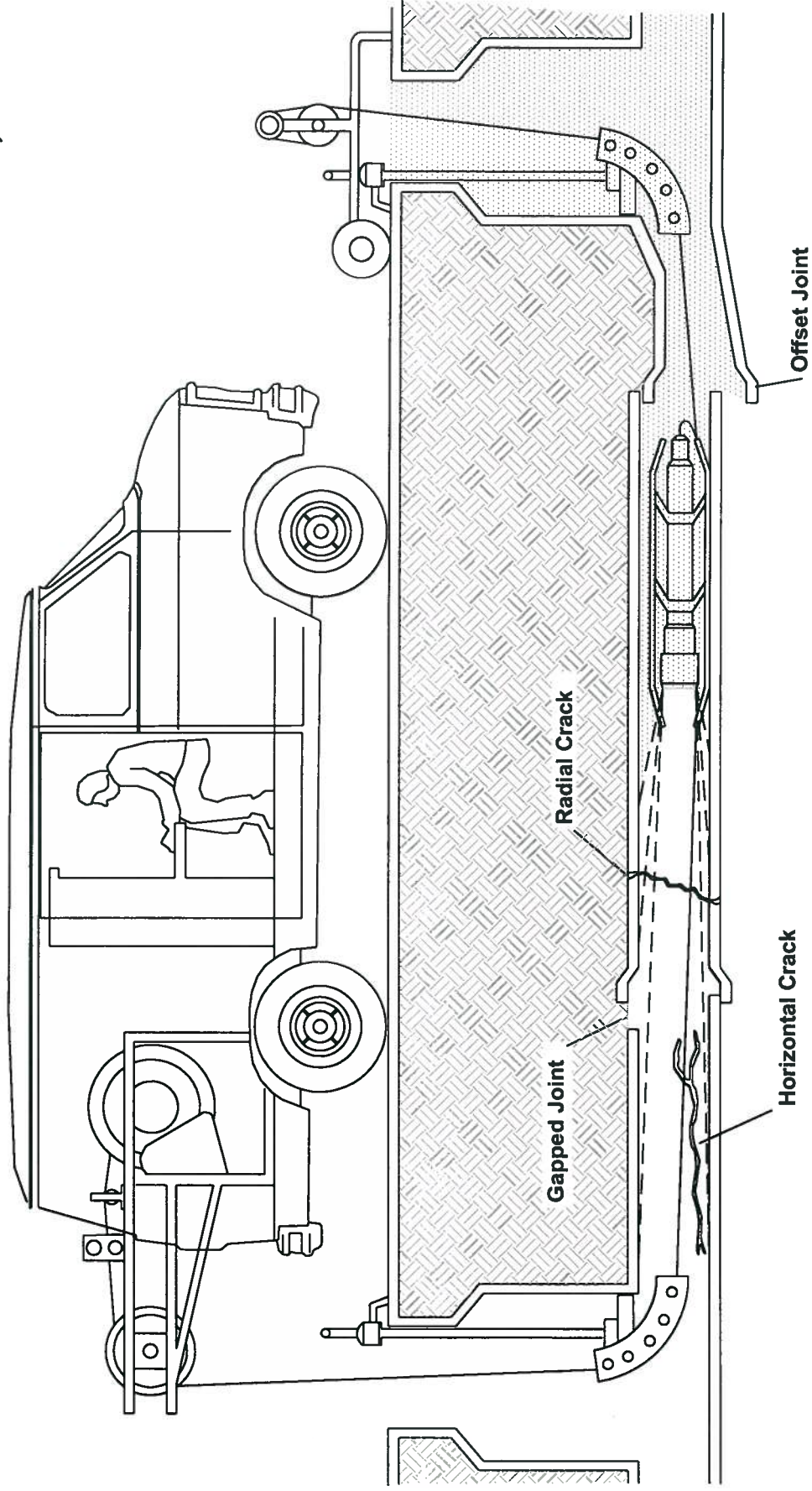
B. TELEVISION INSPECTION

Approximately 6,000 feet of sewer pipe was televised to identify infiltration sources, structural defects, and hydraulic defects.

Television inspection was performed by Johnson County Wastewater (JCW) in 2002 using a video camera that crawled through the sewer line. During the inspection, the view from the camera was observed from the inspection vehicle where the camera operator controlled the camera angle to record the location of all service connections and possible defects. A videotape of the sewer line was prepared which included the position of the camera relative to the starting manhole. A typical inspection setup is shown in Figure 4. Table 3 and Table 4 summarize the identified pipe defects.

Many of the line segments inspected had moderate to severe defects including broken pipe and roots. Twenty-three (23) of the thirty-four (34) line segments need repair. Twenty (20) of the segments require lining with four (4) segments requiring a structural point repair prior to lining. Three (3) segments require full replacement. A list with all recommended repairs is shown in Appendix B-2.

Selected Sewers
Mission Hills, Kansas



**TYPICAL TELEVISION
INSPECTION SETUP**

FIGURE 4

Table 3 - Television Inspection Summary

Observation	Rating (Light.....Moderate.....Heavy)					Total ⁽¹⁾	% of Total Observations
	1	2	3	4	5		
Active Infiltration ⁽³⁾	-	-	-	-	-	1	0.22%
Deposition ⁽³⁾	-	-	-	-	-	1	0.22%
New Manhole ⁽³⁾	-	-	-	-	-	1	0.22%
Unmapped Manhole ⁽³⁾	-	-	-	-	-	2	0.44%
Other ^(2,3)	-	-	-	-	-	25	5.49%
Break-in Connection	9	2	4	0	0	15	3.30%
Broken Pipe	2	2	28	45	5	82	18.02%
Crack - Horizontal	1	9	14	1	0	25	5.49%
Crack - Radial	4	9	3	0	0	16	3.52%
Extended Tap	5	1	1	0	0	7	1.54%
Gapped Joint	0	0	0	1	0	1	0.22%
Offset	0	1	14	5	0	20	4.40%
Roots	56	94	16	4	1	171	37.58%
Sag	1	1	4	2	0	8	1.76%
Scaling	5	8	7	1	0	21	4.62%
Wye Service	50	5	4	0	0	59	12.97%
Total						455	100.00%

Notes

(1) A single line segment may have multiple defect observations.

(2) Other includes location of additional observations including changes in pipe material.

(3) Observed not rated.

Table 4 - Television Infiltration Summary

Observation	Rating	Units ⁽²⁾	Unit Flow (GPM)	Total Infiltration (GPM)
Break-in Conn	3	4	0.001	0.004
Break-in Conn	4	0	0.020	0.000
Break-in Conn	5	0	0.075	0.000
Broken Pipe	1	2	0.020	0.040
Broken Pipe	2	2	0.030	0.060
Broken Pipe	3	28	0.040	1.120
Broken Pipe	4	45	0.050	2.250
Broken Pipe	5	5	0.075	0.375
Crack - Horizontal	1	1	0.001	0.001
Crack - Horizontal	2	9	0.002	0.018
Crack - Horizontal	3	14	0.004	0.056
Crack - Horizontal	4	1	0.008	0.008
Crack - Horizontal	5	0	0.016	0.000
Crack - Radial	1	4	0.001	0.004
Crack - Radial	2	9	0.002	0.018
Crack - Radial	3	3	0.004	0.012
Crack - Radial	4	0	0.008	0.000
Crack - Radial	5	0	0.016	0.000
Extended Tap	3	1	0.002	0.002
Extended Tap	4	0	0.020	0.000
Extended Tap	5	0	0.075	0.000
Gapped Joint	3	0	0.040	0.000
Gapped Joint	4	1	0.050	0.050
Gapped Joint	5	0	0.075	0.000
Infiltration ⁽¹⁾	4	1	1.000	1.000
Offset	3	14	0.040	0.560
Offset	4	5	0.050	0.250
Offset	5	0	0.075	0.000
Roots	1	56	0.001	0.056
Roots	2	96	0.002	0.192
Roots	3	16	0.004	0.064
Roots	4	4	0.008	0.032
Roots	5	1	0.016	0.016
Total		322		6.188

Notes

(1) Infiltration is observed.

(2) A single line segment may have multiple defect observations.

C. BUILDING INSPECTIONS

Private sector building inspections were conducted to locate interior and exterior storm water connections to the sanitary sewer system. Older buildings often used the sanitary sewer system to drain excess storm water away from the building foundation. During building inspections all visible drains are located and discharge locations determined. If no discharge can be determined during the building inspection the source is noted as a suspect source. Suspect basement foundation drains were tested to locate a discharge location during the building inspection to avoid an additional visit requiring the building owners time. Suspect exterior sources were later dyed-water tested to determine the actual discharge location.

A total of sixty-seven (67) building inspections were attempted. Three attempts were made to catch the resident at home for inspections. A total of fifty-six (56) inspections were completed with information from the resident and basement access. Nine (9) external inspections were completed on buildings where the resident was not home and did not respond to requests for an appointment. External inspections could not be completed on two (2) buildings when the resident was not home due to access limitations.

Three (3) sump pumps were determined to be connected to the sanitary sewer system. A total of 188 suspect exterior sources were identified during building inspections and later dyed-water tested to confirm discharge locations. A summary of the building inspection findings is provided in Table 5.

Private sector sources recommended for removal are listed in Appendix A-1. Private sector sources that could not be tested are shown in Appendix A-2.

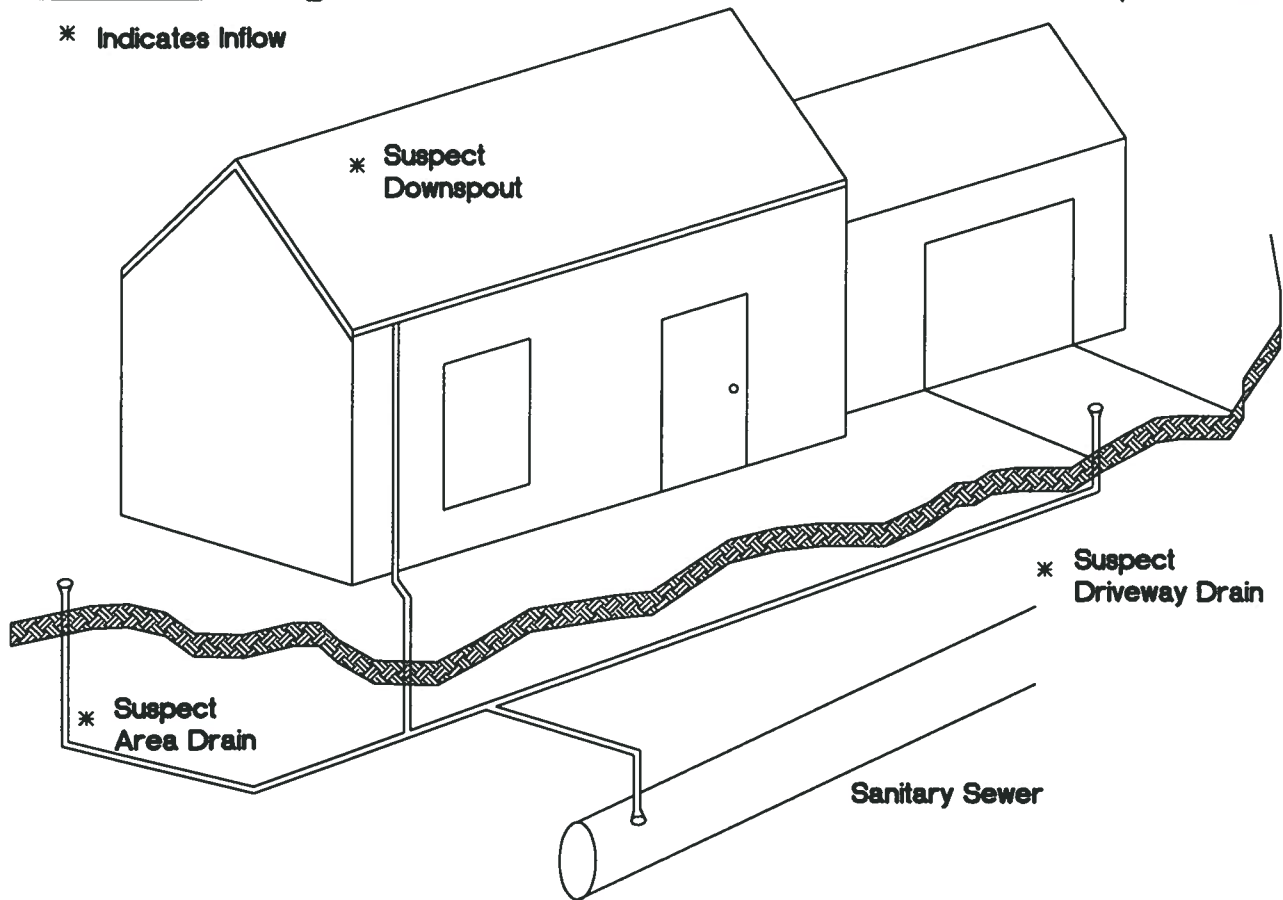
Table 5 - Building Inspection Summary

Source	Suspect (Completed Dyed-Water Test)			Total
	Cannot Test	Negative	Positive	
External				
Area Drain	2	12	0	14
Downspout	47	113	2	162
Driveway Drain	0	7	2	9
Stairwell Drain ⁽²⁾	0	2	1	3
Window Well Drain	0	1	0	1
	49	135	5	189
Internal ⁽¹⁾				
Sump Pump Connection ⁽²⁾	10		3	13
Totals	59	135	8	202
Notes: (1) Thirteen additional sump pump and sump pit discharge locations were unable to be determined due to lack of access. (2) Includes 4 sump pump/pit connections and 1 stairwell drain identified in 2002 inspections completed by GBA, but not included in the private removal recommendations since residence was determined to be served by KCMO sewers.				

External Building Inflow Sources

Mission Hills, Kansas

* Indicates Inflow



Internal Building Inflow Sources

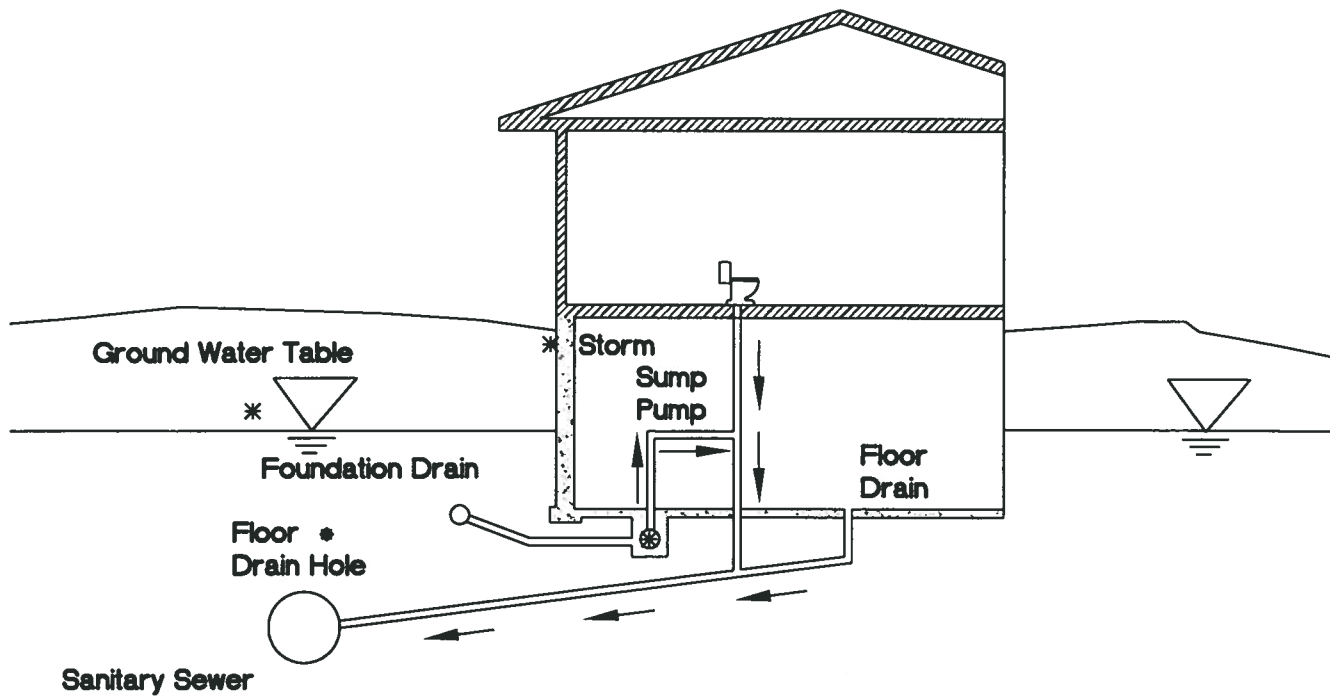


FIGURE 5
TYPICAL INFLOW SOURCES
FOUND DURING BUILDING INSPECTION

D. SMOKE TESTING

Smoke testing is an effective method for identifying and quantifying private and public inflow sources as well as identifying locations of buried or not-found manholes.

Smoke testing is performed on single sewer segments by restricting airflow at the upstream and downstream manholes while introducing a non-toxic smoke into the collection system by means of liquid smoke. The smoke is forced through the system with a gas-powered blower. The smoke exits the system at locations where rainfall or groundwater could enter the system. A three-person crew visually inspects all areas directly tributary to the line segment. A source was considered positive if the smoke was observed in the area of the line segment being tested.

The crew completes a smoke testing form including detailed sketches of positive source and suspect source locations. Photographs were taken as documentation of confirmed sources. Typical defects identified during smoke testing are shown in Figure 6. Figure 7 shows a sample of the types of sources found during smoke testing. A summary of the smoke testing results are shown in Table 6.

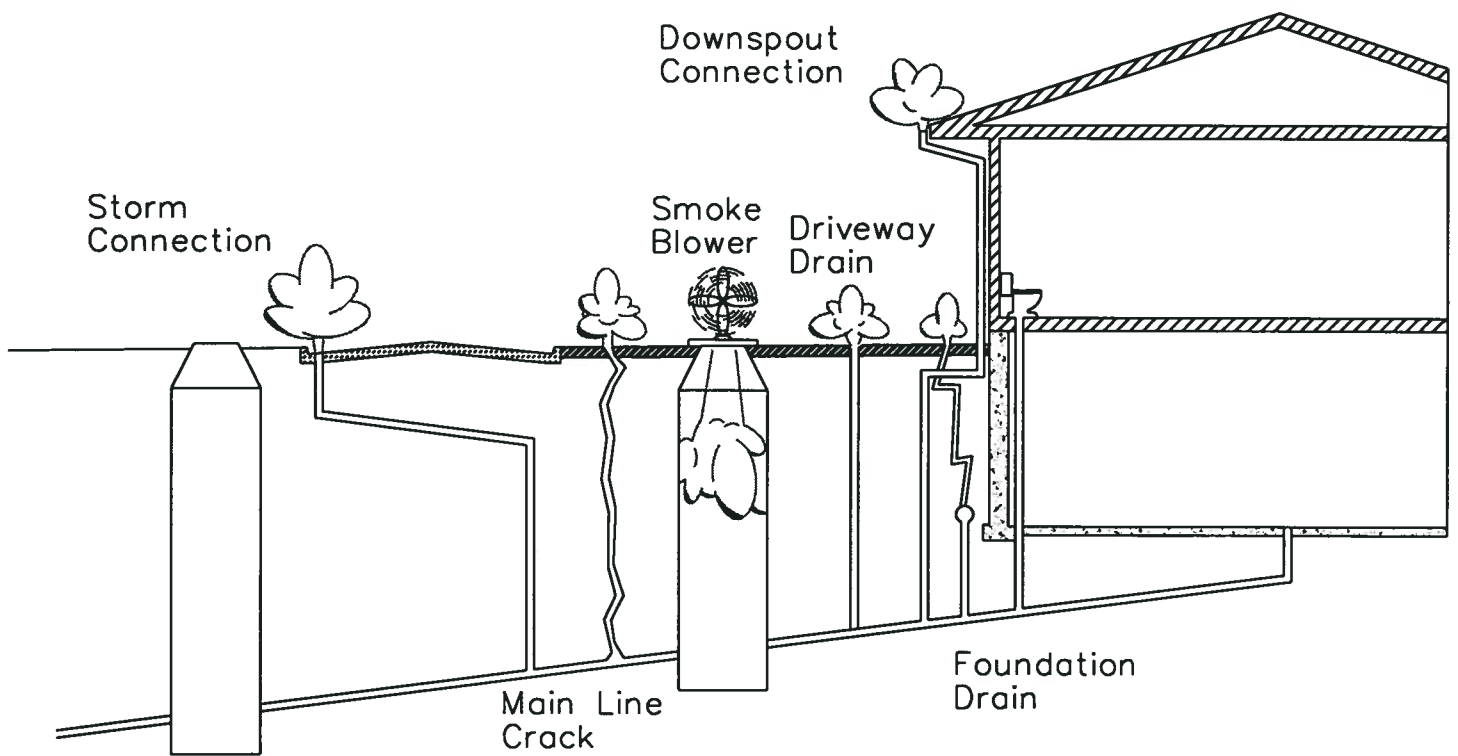
Smoke testing was conducted on approximately 6,000 feet of sanitary sewer pipe in the study area.

Dyed-water testing was performed when possible to determine if large sources, including catch basins, were routed to the sanitary sewer system or if flow was escaping thru defects in the storm system and entering thru defects in the sanitary system. No public storm pipe was found to be routed to the sanitary sewer system, but an alarming amount of storm flow was confirmed to be entering the sanitary sewer system. Additional summarization for each public source identified to be indirectly connected to the sanitary sewer system is included in Appendix C.

Table 6 - Smoke Testing Summary

Source	Positive
Private	
Area Drain	1
Driveway Drain	1
Service Lateral	8
Service Lateral (in storm ditch)	1
Public	
Area Drain	1
Catch Basin	12
Main Sewer	5
Storm Ditch	5
Storm Manhole	3
US Manhole	2
New Manhole	1
Flood Gate in Manhole	1
Total	
	41

Selected Sewers
Mission Hills, Kansas



TYPICAL SEWER
DEFECTS FOUND DURING
SMOKE TESTING

FIGURE 6

PHOTOGRAPHIC RECORD SHEET

FIGURE 7

GEORGE BUTLER ASSOCIATES, INC.
ENGINEERS & ARCHITECTS

CLIENT: Johnson County Wastewater
PROJECT: Mission Hills Selected Sewers



Segment: 17-1 to 17-2

Description:
Smoking Catch Basin.
Dyed-water test was
not completed because
the only hydrants
located nearby are on
KCMO water. The
dyed-water test results
are included in
Appendix C.



Segment: 14-3 to 18-5

Description: Heavy
smoke from storm
ditch. Indirect
connection with light
dye observed but
crews were unable to
simulate storm
conditions.

E. DYED-WATER TESTING

GBA field inspectors conducted dyed-water tests on suspect inflow sources for the following reasons:

- Determine if suspect sources identified during building inspections were connected to the sanitary sewer system.
- Determine if storm sewer catch basins identified as positive sources during smoke testing were routed to the sanitary sewer or if the positive smoke test was due to a combination of defects in the sanitary and storm systems.

Suspect sources were tested by introducing dyed-water into the source. A source is considered positive if the dye is observed in the downstream sewer manhole. Typically, one half hour was allowed for a source to activate. Inspection photographs were used to document positive I/I sources.

Identified sources in the private sector included driveway drains and downspouts that were confirmed to be positive. Public dyed-water test results indicated the positive smoke results were caused by defects within the storm and sanitary systems, not direct routing. Table 7 summarizes the results of the dyed-water testing. The outcome of the dyed-water tests conducted on private sources is included with the building inspection summary on Page 14. A more thorough account of public dyed-water test results including observations and recommendations for each site, can be found in Appendix C. Private sources identified by dyed-water testing are included in Appendix A-1.

A number of suspect sources could not be tested due to access, clogged piping and water availability. The private suspect sources and the reasons they could not be tested are listed in Appendix A-2.

Table 7 – Dyed-Water Test Summary

	Attempted	Positive	Negative	Cannot Test
Private Sources ⁽¹⁾	188	4	135	49
Public Sources ⁽²⁾	15	7	1	7
Total	203	11	136	56

Notes:

(1) Private sources were identified during building inspections

(2) Public sources were identified during smoke testing.

F. I/I SOURCE DISTRIBUTION

A summary of the positive sources identified by the previously described testing is shown in Table 8.

Table 8 - I/I Source Distribution

Source	# of Sources	Average ⁽⁵⁾ 1-Year Inflow (gpm)	Total 1-Year Inflow (gpm)	% of Identified Flow
Private				
Area Drain	1	11.59	11.59	0.48%
Driveway Drain ⁽¹⁾	2	14.17	28.33	1.17%
Stairwell Drain	1	0.39	0.39	0.02%
Downspout	2	20.61	41.21	1.70%
Service Lateral	8	3.00	24.00	0.99%
Sump Pump Connection	3	9.00	27.00	1.11%
Service Lateral (in storm ditch) ⁽²⁾	1	178.53	178.53	7.36%
Public				
Area Drain	1	12.36	12.36	0.51%
Catch Basin ⁽³⁾	12	113.25	1,359.00	56.04%
Main Sewer	5	4.40	22.00	0.91%
Storm Ditch ⁽²⁾	5	128.60	643.00	26.51%
US Manhole	2	1.50	2.99	0.12%
Manhole Defects ⁽⁴⁾	138	0.54	74.72	3.08%
Totals	181		2,425.12	100.00%

Notes:

- (1) One driveway drain was positive, but was redirected to new sump with external discharge on 1/28/05.
- (2) Storm ditch flows estimated.
- (3) No direct catch basin connections have been found. Flows are estimated.
- (4) Manhole flows are based on manhole inspections completed by The Larkin Group.
- (5) Average 1-Year Inflow = Total Inflow / # of Sources.

CHAPTER 3

CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

1. Manhole Inspections and Line Lamping

Generally the manhole inspections conducted by GBA concluded that most manholes need repair. The ten inspections completed by GBA identified six (6) times as many component defects than the inspections completed by The Larkin Group on the same ten manholes. Based on the findings of the ten (10) manholes inspected by GBA, it appears that all thirty-two (32) manholes may require repair and should be revisited during design.

2. Review Television Inspection Tapes

Generally the main lines televised were found to have broken pipe and roots. One segment not included on the television inspection tapes was lamped to determine defects. Twenty-three (23) of thirty-four (34) line segments are recommended for repair based on television tape review or line lamping. A few locations have a directional bend in the pipe. The new alignment from manhole 1-14 to manhole 3-4 has a significant bend (close to 90 degrees) between manholes. A new manhole is recommended at the location of the bend.

3. Smoke Testing

Smoke testing was completed on all thirty-four (34) segments identifying forty-one (41) sewer line defects and other sources. Many of the sources were located in or near storm channels and have the potential to allow high amounts of I/I to enter the sanitary sewer system. One such area included the main sewer line located between State Line Road and Mission Road. The five (5) pipe segments on Brookwood Road are located next to a storm ditch and had heavy and extensive smoke suggesting numerous leaks along the main sewer line. Television inspection confirmed roots at numerous joints as well as some areas of broken pipe where infiltration could enter the sanitary sewer system.

4. Building Inspections

Building inspections were attempted for 67 buildings and completed for 56 buildings resulting in the identification of three (3) sump pumps discharging to the sanitary sewer and four (4) external sources. Several locations were difficult to inspect due to finished basements. Also, several locations had newly installed storm lines provided by the City of Mission Hills, for the residents to connect private storm water discharges. There were several instances where homeowners had taken advantage of the new storm lines. Sources typically identified in older neighborhoods, may have been re-routed to the new storm system in recent years.

B. RECOMMENDED PLAN

The recommended plan for the Selected Sewers in Mission Hills is shown in Table 9 and Figure 8 and includes the following recommendations:

1. Manhole Rehabilitation

All manholes are expected to require some rehabilitation and are recommended for review prior to design to determine the type of repair required. The completed preliminary manhole recommendations are included in Appendix B-1.

2. Pipe Segment Rehabilitation

Recommended line segment rehabilitation is based on the television inspection tapes completed by JCW in December 2002 and should be checked against any repairs completed by KCMO in the last two years. The television inspection results for each segment along with recommended repair are shown in Appendix B-2.

3. Public and Private Inflow Source Removal

Private and public inflow sources recommended for removal are listed in Appendix A. Additional public inflow source recommendations are included in Appendix C.

4. Additional Television Inspection

Additional television inspection is recommended for segments recommended for CIPP where the television inspection was not completed due to removable obstructions like roots or debris. Lines recommended for additional television inspection are included in the table in Appendix C.

5. Additional Manhole Inspections

Buried manholes are recommended for inspection after they have been located and uncovered. Also recommended for inspection are new manholes found during television inspection and manholes replaced by KCMO since The Larkin Group completed inspections in 2001. Any additional inspections may result in additional recommendations to the table in Appendix B-1.

6. Disconnect Abandoned Sewers

Confirm that all services along abandoned sewers are inactive. Disconnect abandoned lines and manholes from the sanitary sewer system. Lines recommended to be abandoned are included in the Additional Investigations table in Appendix C.

7. Notify the City of Mission Hills for Storm Defects

Notify the City of Mission Hills where high concentrations of flow and dye were seen escaping from the storm sewer system indicating problems with the storm system.

8. Additional Investigations

Testing from this project identified numerous indirect I/I sources with the potential to greatly limit the capacity of the sanitary sewer system during large storm events. Many indirect connections will be eliminated with main sewer line repairs and manhole repairs. Indirect connections were dyed-water tested when possible. Some locations were unable to be tested due to traffic, lack of available water, or inability to plug the storm line. Recommended additional testing is described below. Recommendations for additional investigations are included in the table in Appendix C.

a. Dyed-Water Test with Traffic Control

Two catch basins located near State Line road will require additional assistance for traffic control to be able to complete dyed-water testing.

b. Dyed-Water Test using Additional Water Source

Several catch basins that tested positive during smoke testing were located too far from usable fire hydrants to dyed-water test. A larger source of water or access to fire hydrants located on the Missouri side of State Line Road is necessary to complete the dyed-water test.

c. Dyed-Water Test with Concurrent TV

Numerous mainline sources need to be tested with concurrent television inspection to determine if I/I is coming from direct connections, leaking service laterals or from main line defects. Once the source has been located, effective rehabilitation or repair methods can be recommended to address the problem.

d. Post Rehabilitation Smoke Testing

Some inflow sources identified during smoke testing can not be located thru dyed-water testing. The lines associated with these sources are recommended for smoke testing after rehabilitation has been complete to verify that all inflow sources have been removed.

Table 9 - Recommended System Plan

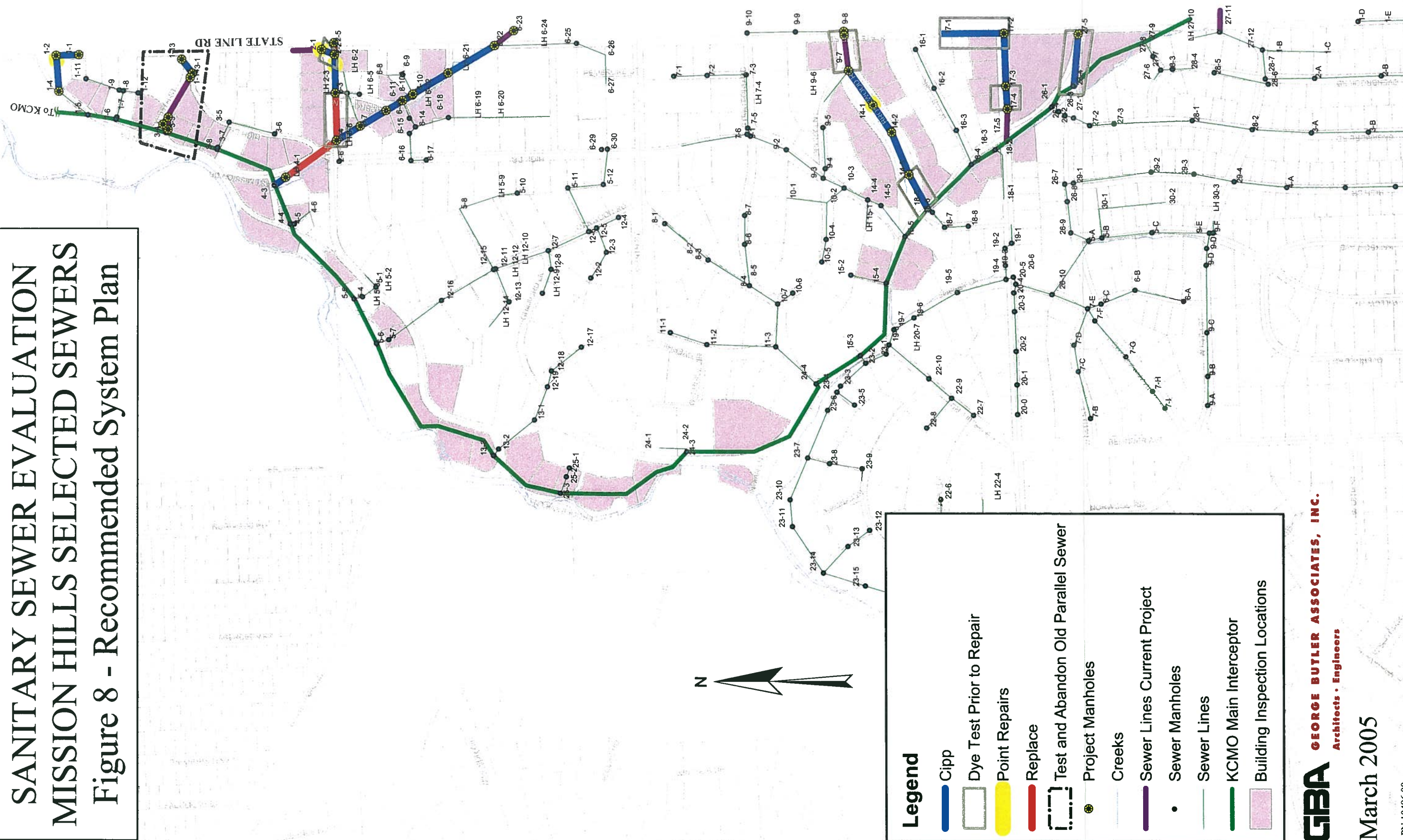
Source	Units	Quantity	Unit Cost	Estimated Construction Costs	Estimated Capital Costs ⁽²⁾
Additional Investigations					
Additional Television Inspection	Feet	940	\$2	---	\$1,880
Additional Manhole Inspection ⁽³⁾	Each	4	\$100	---	\$400
Dyed-Water Test ⁽⁴⁾	Each	7	\$500	---	\$3,500
Post-Rehabilitation Smoke Testing ⁽⁵⁾	Feet	843	\$2	---	\$1,686
					<u>\$7,466</u>
Private Sources for Disconnection					
Area Drain	Each	1	\$2,000	\$2,000	\$2,800
Driveway Drain ⁽¹⁾	Each	2	\$2,000	\$4,000	\$5,600
Stairwell Drain	Each	1	\$5,000	\$5,000	\$7,000
Downspout	Each	2	\$500	\$1,000	\$1,400
Service Laterals	Each	8	\$4,000	\$32,000	\$44,800
Sump Pump Connection	Each	3	\$1,500	\$4,500	\$6,300
Service Lateral (in storm ditch)	Each	1	\$4,000	\$4,000	\$5,600
				<u>\$52,500</u>	<u>\$73,500</u>
Public Repairs					
Manhole Rehabilitation	Each	29	\$2,355	\$68,300	\$95,620
Main Sewer Rehabilitation	Feet	4,795	\$58	\$276,118	\$386,565
Catch Basin (Area Drain)	Each	1	\$2,000	\$2,000	\$2,800
Disconnect Abandoned Segments ⁽⁷⁾	Cubic Yard	5	\$95	\$475	\$665
Disconnect Abandoned Manholes	Each	2	\$500	\$1,000	\$1,400
				<u>\$347,893</u>	<u>\$487,050</u>
Totals				\$400,393	\$568,016

Notes:

- (1) One additional driveway drain was positive, but was redirected to new sump with external discharge on 1/28/05.
- (2) Capital Cost includes 40% of contingency, engineering, legal, and administrative costs for construction type items.
- (3) No current inspection due to buried or previously not found.
- (4) Dyed-water test requiring extensive traffic control, major water source and/or concurrent sewer televising.
- (5) To verify if CIPP was effective in eliminating I/I sources.
- (6) Service connections may require replacement based on additional dyed-water testing.
- (7) Cost for flowable fill for abandoned pipes.

**SANITARY SEWER EVALUATION
MISSION HILLS SELECTED SEWERS**

Figure 8 - Recommended System Plan



Appendix A-1
Direct Inflow Sources Recommended for Removal

Owner	Source	Address	1-Year Storm Flow (GPM)	Comments
Private	Area Drain	5601 Pembroke Ln	11.59	
Private	Driveway Drain	2115 Brookwood	12.88	
Private	Driveway Drain	2001 Brookwood	15.45	
Private	Downspout	5407 Mission Dr	25.76	
Private	Downspout	5407 Mission Dr	15.45	
Private	Stairwell Drain	1900 Drury Ln	0.39	Dye Tested in 2002
Private	Sump Pump	5800 Brookbank	9.00	In crawl space. 2 pumps at a basement elevation (3 feet lower) discharge outside.
Private	Sump Pump	2021 Brookwood	9.00	Temporarily connected during construction
Private	Sump Pump	5821 Brookbank	9.00	
Public	Catch Basin (Area Drain)	55th St. & State Line Rd (E. Side)	80.49	Ties into manhole 1-1
Total			189.01	
Note:				
(1) Area drain at 6125 Mission Dr. was redirected to new sump with external discharge on 1/28/05.				

PUBLIC INFLOW SOURCE FOR REMOVAL



Line Segment and Location

The line segment 1-1 to 1-2 is located on State Line Rd running north towards Mission Dr.

Smoke Testing Results

Heavy smoke was observed coming from an area drain located at the back of curb on the east side of State Line Rd.

Dyed-Water Flooding Results

Dyed-water poured into the area drain and dye was observed entering through the east incoming line at manhole 1-1, apparently a storm line. The storm line is directly connected to manhole 1-1.

Recommendations

It is recommended that the storm line be removed from manhole 1-1 and re-routed to the storm sewer. Another option may be to remove the area drain since it drains a small area.

SMOKE TEST FORM

Client name: JCW - Mission Hills

Project No. 10496

1. UPSTREAM MANHOLE: 1-1

DOWNSTREAM MANHOLE: 1-2

2. DATE: 9, 10, 04

INSPECTION CREW: RC/RB/JR

RESULTS: POS / SUS / NEG / CANNOT TES

OBS#	SOURCE ADDRESS/LOCATION (ALL POSITIVE AND SUSPECT)	RESULT	STATUS	SOURCE TYPE	SMOKE	AREA	RUN OFF	TV Y/N	ROLL/ PHOTO#
1	AREA DRAIN E. SIDE OF STATE LINE	1	2	6	3	16 2001	1	Y	9/40
2									
3									
4									
5									
6									
7									
8									
9									
10									

RESULT CODES

1. POSITIVE
2. SUSPECT
3. NEGATIVE
4. CANNOT TEST

STATUS CODES

1. PRIVATE
2. PUBLIC

SOURCE TYPE CODES

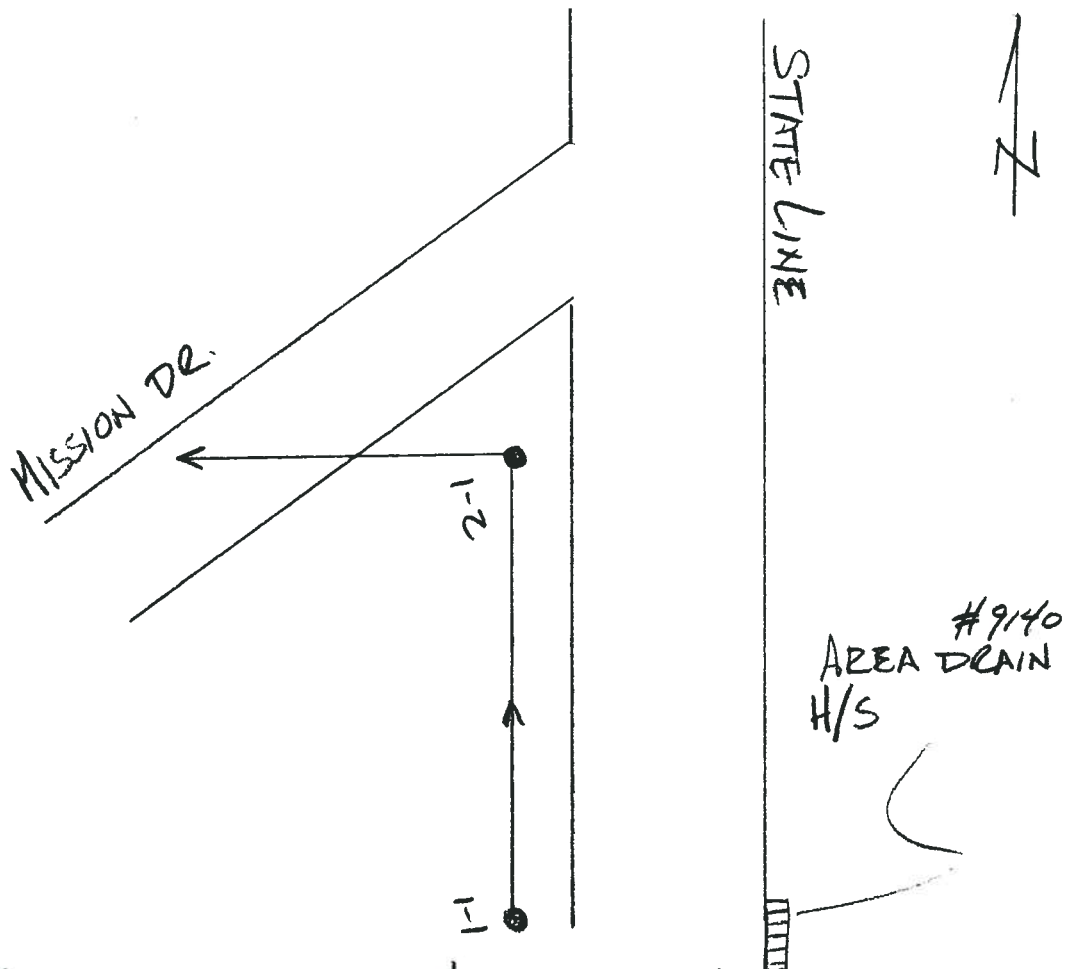
1. SERVICE LATERALS
2. TRANSITION JOINT
3. DRIVEWAY DRAIN
4. WINDOW WELL DRAIN
5. STAIRWELL DRAIN
6. AREA DRAIN
7. DOWNSPOUT
8. DOWNSPOUT CONNECT.
9. FOUNDATION DRAIN
10. BUILDING INSIDE
11. CATCH BASIN
12. STORM DITCH
13. STORM MANHOLE
14. MAIN SEWER
15. UPSTREAM MANHOLE
16. CLEANOUT
17. CRAWL SPACE
18. OTHER

SMOKE CODES

1. LIGHT
2. MEDIUM
3. HEAVY

RUNOFF CODES

1. 0% PAVED
2. 25% PAVED
3. 50% PAVED
4. 75% PAVED
5. 100% PAVED



COMMENTS: POSSIBLE DIRECT CONNECT W/ SANITARY SEWER

Appendix A-2
Inflow Sources – Cannot Test

Building Observation Master Report

CANNOT TEST

3/1/2005
8:39:54AM

Obs #	Source Results Date Address	Length Runoff GPM	Width	Flow Lock Roll # Picture # Facility	Distance Measrd From Turn Distance Turn Direction	X Coord Y Coord % I/I Removed Remain GPM	Dye Date Dye Results Dye Crew	Dye Start Time Dye End Time Dye Roll # Dye Picture #	US Structure DS Structure Flow Basin
9	Downspout Suspect 9/23/2004 5839 BROOKBANK TOO TALL	12.0 5 3.09	20.0	False	0.0	0.0 0.0 3.09	Cannot Test		
10	Downspout Suspect 9/23/2004 5839 BROOKBANK GUTTERS TOO TALL TO REACH, SEALED AT BOTTOM	10.0 5 1.93	15.0	False	0.0	0.0 0.0 1.93	10/5/2004 Cannot Test RB/JR	11:07 11:21	
11	Downspout Suspect 9/23/2004 5839 BROOKBANK TOO TALL	10.0 5 1.93	15.0	False	0.0	0.0 0.0 1.93	Cannot Test		
13	Downspout Suspect 9/23/2004 5839 BROOKBANK	15.0 5 2.90	15.0	False	0.0	0.0 0.0 2.90	Cannot Test		
3	Downspout Suspect 8/16/2004 5407 Mission Dr. NO OPENING	30.0 5 11.59	30.0	False	0.0	0.0 0.0 11.59	Cannot Test		1-4 1-5 8
4	Downspout Suspect 8/16/2004 5407 Mission Dr. DRIVEWAY INACCESSIBLE, BACKYARD TOO FAR TO TEST.	40.0 5 15.45	30.0	False	0.0	0.0 0.0 15.45	Cannot Test		1-4 1-5 8
5	Downspout Suspect 8/16/2004 5407 Mission Dr. DRIVEWAY INACCESSIBLE, BACKYARD TOO FAR TO TEST.	40.0 5 15.45	30.0	False	0.0	0.0 0.0 15.45	Cannot Test		1-4 1-5 8

Building Observation Master Report

CANNOT TEST

3/1/2005
8:39:54AM

Obs #	Source Results Date Address	Length Runoff GPM	Width	Flow Lock Roll # Picture # Facility	Distance Measrd From Turn Distance Turn Direction	X Coord Y Coord % I/I Removed Remain GPM	Dye Date Dye Results Dye Crew	Dye Start Time Dye End Time Dye Roll # Dye Picture #	US Structure DS Structure Flow Basin
6	Downspout Suspect 8/16/2004 5407 Mission Dr.	40.0 5 15.45	30.0	False	0.0	0.0 0.0 15.45	Cannot Test		1-4 1-5 8
DRIVEWAY INACCESSIBLE, BACKYARD TOO FAR TO TEST.									
5	Area Drain Suspect 8/16/2004 5519 Mission Dr.	15.0 0.00	10.0	False	0.0	0.0 0.0 0.00	Cannot Test		3-5 3-7 8
LOCKED GATE									
6	Downspout Suspect 8/16/2004 5519 Mission Dr.	30.0 5 3.86	10.0	False	0.0	0.0 0.0 3.86	Cannot Test		3-5 3-7 8
LOCKED GATE									
7	Downspout Suspect 8/16/2004 5519 Mission Dr.	20.0 5 3.86	15.0	False	0.0	0.0 0.0 3.86	Cannot Test		3-5 3-7 8
LOCKED GATE									
8	Downspout Suspect 8/16/2004 5519 Mission Dr.	10.0 5 2.58	20.0	False	0.0	0.0 0.0 2.58	Cannot Test		3-5 3-7 8
LOCKED GATE									
9	Downspout Suspect 8/16/2004 5519 Mission Dr.	10.0 5 1.93	15.0	False	0.0	0.0 0.0 1.93	Cannot Test		3-5 3-7 8
LOCKED GATE									
1	Downspout Suspect 8/16/2004 5620 Mission Dr.	15.0 5 2.90	15.0	False	0.0	0.0 0.0 2.90	Cannot Test		5-7 5-6 7
GUTTER TOO HIGH, SEALED AT BOTTOM									

Building Observation Master Report

CANNOT TEST

3/1/2005
8:39:54AM

Obs #	Source Results Date Address	Length Runoff GPM	Width	Flow Lock Roll # Picture # Facility	Distance Measrd From Turn Distance Turn Direction	X Coord Y Coord % I/I Removed Remain GPM	Dye Date Dye Results Dye Crew	Dye Start Time Dye End Time Dye Roll # Dye Picture #	US Structure DS Structure Flow Basin
3	Downspout Suspect 8/16/2004 5620 Mission Dr.	15.0 5 2.90	15.0	False	0.0	0.0 0.0 2.90	10/4/2004 Cannot Test		5-7 5-6 7
GUTTER TOO HIGH, SEALED AT BOTTOM									
1	Downspout Suspect 8/6/2004 2001 BROOKWOOD CLOGGED GUTTER	15.0 5 2.90	15.0	False	0.0	0.0 0.0 2.90	Cannot Test	14:02 14:18	9-7 14-1 8
3	Downspout Suspect 8/6/2004 2001 BROOKWOOD CLOGGED	20.0 5 7.73	30.0	False	0.0	0.0 0.0 7.73	Cannot Test	14:40 14:43	9-7 14-1 8
4	Downspout Suspect 8/9/2004 6120 Mission Dr.	20.0 0.00	30.0	False	0.0	0.0 0.0 0.00	Cannot Test		15-2 15-4 8
5	Downspout Suspect 8/9/2004 6120 Mission Dr.	30.0 0.00	30.0	False	0.0	0.0 0.0 0.00	Cannot Test		15-2 15-4 8
6	Downspout Suspect 8/9/2004 6120 Mission Dr.	30.0 0.00	20.0	False	0.0	0.0 0.0 0.00	Cannot Test		15-2 15-4 8
7	Downspout Suspect 8/9/2004 6120 Mission Dr.	30.0 0.00	20.0	False	0.0	0.0 0.0 0.00	Cannot Test		15-2 15-4 8
8	Downspout Suspect 8/9/2004 6120 Mission Dr.	25.0 0.00	25.0	False	0.0	0.0 0.0 0.00	Cannot Test		15-2 15-4 8

Building Observation Master Report

CANNOT TEST

3/1/2005
8:39:54AM

Obs #	Source Results Date Address	Length Runoff GPM	Width	Flow Lock Roll # Picture # Facility	Distance Measrd From Turn Distance Turn Direction	X Coord Y Coord % I/I Removed Remain GPM	Dye Date Dye Results Dye Crew	Dye Start Time Dye End Time Dye Roll # Dye Picture #	US Structure DS Structure Flow Basin
1	Downspout Suspect 8/9/2004 6120 Mission Dr.	30.0	20.0	False	0.0	0.0	0.0	Cannot Test	15-2 15-4 8
2	Downspout Suspect 8/9/2004 6120 Mission Dr.	20.0	20.0	False	0.0	0.0	0.0	Cannot Test	15-2 15-4 8
3	Downspout Suspect 8/9/2004 6120 Mission Dr.	20.0	20.0	False	0.0	0.0	0.0	Cannot Test	15-2 15-4 8
7	Downspout Suspect 8/12/2004 6131 Mission Dr. NOT ACCESSIBLE	20.0 5 3.86	15.0	False	0.0	0.0	0.0	Cannot Test	14-3 18-5 8
1	Downspout Suspect 8/10/2004 5708 State Line GUTTERS TOO TALL, SEALED AT BOTTOM	20.0 5 5.15	20.0	False	0.0	0.0	0.0	Cannot Test	6-21 6-10 8
2	Downspout Suspect 8/10/2004 5708 State Line GUTTERS TOO HIGH, SEALED AT BOTTOM	20.0 5 5.15	20.0	False	0.0	0.0	0.0	Cannot Test	6-21 6-10 8
3	Downspout Suspect 8/10/2004 5708 State Line GUTTERS TOO HIGH, SEALED AT BOTTOM	10.0 5 1.29	10.0	False	0.0	0.0	0.0	Cannot Test	6-21 6-10 8
4	Downspout Suspect 8/10/2004 5708 State Line	10.0 5 1.29	10.0	False	0.0	0.0	0.0	Cannot Test	6-21 6-10 8

Building Observation Master Report

CANNOT TEST

3/1/2005
8:39:54AM

Obs #	Source Results Date Address	Length Runoff GPM	Width	Flow Lock Roll # Picture # Facility	Distance Measrd From Turn Distance Turn Direction	X Coord Y Coord % I/I Removed Remain GPM	Dye Date Dye Results Dye Crew	Dye Start Time Dye End Time Dye Roll # Dye Picture #	US Structure DS Structure Flow Basin
GUTTERS TOO HIGH, SEALED AT BOTTOM									
5	Downspout Suspect 8/10/2004	10.0 5	10.0	False	0.0	0.0 0.0	Cannot Test		6-21 6-10 8
	5708 State Line	1.29		Mission Hills	0.0	1.29			
GUTTERS TOO HIGH, SEALED AT BOTTOM									
6	Downspout Suspect 8/10/2004	15.0 5	15.0	False	0.0	0.0 0.0	Cannot Test		6-21 6-10 8
	5708 State Line	2.90		Mission Hills	0.0	2.90			
GUTTERS TOO HIGH, SEALED AT BOTTOM									
9	Downspout Suspect 8/10/2004	10.0 5	15.0	False	0.0	0.0 0.0	Cannot Test		6-21 6-10 8
	5708 State Line	1.93		Mission Hills	0.0	1.93			
COULD NOT REACH									
1	Downspout Suspect 8/12/2004	5		False	0.0	0.0 0.0	Cannot Test RC		2-4 4-1 8
	2100 W 56TH ST	0.00		Mission Hills	0.0	0.00			
NOT HOME									
1	Downspout Suspect 9/23/2004	10.0 5	20.0	False	0.0	0.0 0.0	Cannot Test		
	5839 BROOKBANK	2.58		Mission Hills	0.0	2.58			
TOO TALL									
2	Downspout Suspect 9/16/2004	5.0 5	10.0	False	0.0	0.0 0.0	Cannot Test	10:00 10:05	
	5900 MISSION DR	0.64		Mission Hills	0.0	0.64			
DS CLOGGED (SAME GUTTER AS #3)									
3	Downspout Suspect 9/16/2004	5.0 5	10.0	False	0.0	0.0 0.0	Cannot Test	10:00 10:05	
	5900 MISSION DR	0.64		Mission Hills	0.0	0.64			
DS CLOGGED (SAME GUTTER AS #2)									

Building Observation Master Report

CANNOT TEST

3/1/2005
8:39:54AM

Obs #	Source Results Date Address	Length Runoff GPM	Width	Flow Lock Roll # Picture # Facility	Distance Measrd From Turn Distance Turn Direction	X Coord Y Coord % I/I Removed Remain GPM	Dye Date Dye Results Dye Crew	Dye Start Time Dye End Time Dye Roll # Dye Picture #	US Structure DS Structure Flow Basin
4	Downspout Suspect 9/16/2004 5900 MISSION DR TOO TALL	5.0 5 0.97	15.0	False	0.0	0.0 0.0 0.97	Cannot Test		
4	Downspout Suspect 8/4/2004 6400 State Line CLOGGED	40.0 5 25.76	50.0	False	0.0	0.0 0.0 25.76	Cannot Test		27-5 27-4 8
5	Downspout Suspect 8/4/2004 6400 State Line CLOGGED	10.0 5 1.29	10.0	False	0.0	0.0 0.0 1.29	Cannot Test		27-5 27-4 8
6	Downspout Suspect 8/4/2004 6400 State Line CLOGGED	10.0 5 1.29	10.0	False	0.0	0.0 0.0 1.29	Cannot Test		27-5 27-4 8
3	Area Drain Suspect 8/16/2004 5415 Mission Dr. COULD NOT REACH	10.0 4 2.90	25.0	False	0.0	0.0 0.0 2.90	Cannot Test		1-4 1-5 8
5	Downspout Suspect 8/16/2004 5415 Mission Dr. COULD NOT REACH	15.0 5 3.86	20.0	False	0.0	0.0 0.0 3.86	Cannot Test		1-4 1-5 8
6	Downspout Suspect 8/16/2004 5415 Mission Dr. COULD NOT REACH	20.0 5 5.15	20.0	False	0.0	0.0 0.0 5.15	Cannot Test		1-4 1-5 8

Building Observation Master Report

CANNOT TEST

3/1/2005
8:39:54AM

Obs #	Source Results Date Address	Length Runoff GPM	Width	Flow Lock Roll # Picture # Facility	Distance Measrd From Turn Distance Turn Direction	X Coord Y Coord % I/I Removed Remain GPM	Dye Date Dye Results Dye Crew	Dye Start Time Dye End Time Dye Roll # Dye Picture #	US Structure DS Structure Flow Basin
4	Downspout Suspect 9/23/2004 5839 BROOKBANK TOO TALL	15.0 5 2.90	15.0	False	0.0 0.0	0.0 0.0 2.90	Cannot Test		
6	Downspout Suspect 9/23/2004 5839 BROOKBANK TOO TALL	15.0 5 4.83	25.0	False	0.0 0.0	0.0 0.0 4.83	Cannot Test		
1	Downspout Suspect 8/11/2004 5527 E MISSION DR HOSE DOES NOT REACH	10.0 5 1.93	15.0	False	0.0 0.0	0.0 0.0 1.93	Cannot Test		
5	Downspout Suspect 9/16/2004 5900 MISSION DR TOO TALL	15.0 5 0.97	5.0	False	0.0 0.0	0.0 0.0 0.97	Cannot Test		
7	Downspout Suspect 9/16/2004 5900 MISSION DR TOO TALL	15.0 5 2.90	15.0	False	0.0 0.0	0.0 0.0 2.90	Cannot Test		

Appendix B-1
Manholes Recommended for Rehabilitation

Appendix B-1 - Manholes Recommended for Rehabilitation

3/2/2005

Structure	Location	Surface	Cover Type	Cover Defects	Frame Defects	Frame Seal Defects	Grade Adjustment Defects	Cone Defects	Wall Defects	Bench Defects	Trough Defects	Install New Manhole	Cost
1-1	State Line Road & Mission Dr.	Sidewalk	Vented	X		X	X	X	X				\$1,850
1-2	State Line Road & Mission Dr.	Sidewalk	Vented	X		X			X				\$1,400
1-3	State Line Road and Mission Drive	DNE											
1-4	State Line Road & Mission Dr.	Grass	Vented	X		X		X	X				\$1,850
1-13	State Line & 55th Street	Grass	Pick	X		X	X		X				\$2,300
1-14	High Drive & 55th Street	Street	Vented	X									\$150
2-1	Corner of State Line & 56th Street	Sidewalk	Pick					X	X	X			\$1,950
2-2	56th & State Line	Grass	Vented	X									\$150
2-3	Pembroke & 56th Street [Lamp Hole]	Grass	Pick									X	\$3,500
2-5	56th St. & State Line	Grass	Vented	X			X	X	X	X			\$2,550
3-1	56th St. & High Drive, In Street	Street	Pick	X		X	X	X	X				\$2,750
3-2	55th Street and Mission Drive	ABANDONED											
3-3	55th Street and Mission Drive	ABANDONED											
4-1	Shadow Lane & East Mission Drive [Lamp Hole]	Grass										X	\$3,500
6-7	Backyard - west by creek	Grass	Vented	X		X		X	X				\$2,300
6-7(a) ⁽¹⁾		NOT MAPPED											
6-10	beside sidewalk	Grass	Vented	X	X	X		X	X				\$2,300
6-10A	Sidewalk along Pembroke	Sidewalk	Vented	X		X	X		X	X			\$2,800
6-11	In grass easement	Grass	Pick			X	X		X	X			\$2,650
6-22 ⁽¹⁾	State Line 250 feet South of Pembroke	REPLACED											
6-23	50 ft. from State Line on 58th Street	Street	Pick	X	X	X		X	X	X			\$3,250
9-7	Brookwood & Drury	Grass	Vented	X					X	X			\$1,650
9-7(a) ⁽¹⁾		NOT MAPPED							X	X	X		\$2,000
9-8	State Line Rd. & 61st St.	Grass	Pick	X		X			X	X			\$2,350
14-1	State Line & Brookwood Road	Grass	Vented	X		X	X	X	X	X			\$3,250
14-2	State Line & Brookwood	Grass	Vented	X		X		X	X	X	X		\$3,300
14-3	Mission Drive & Brookwood	Grass	Vented	X		X		X	X	X			\$2,800

Appendix B-1 - Manholes Recommended for Rehabilitation

3/2/2005

Structure	Location	Surface	Cover Type	Cover Defects	Frame Defects	Frame Seal Defects	Grade Adjustment Defects	Cone Defects	Wall Defects	Bench Defects	Trough Defects	Install New Manhole	Cost
17-1 ⁽¹⁾	Along State Line Road	BURIED					X						\$450
17-2	State Line & 63rd Street	Street	Pick			X		X	X				\$2,150
17-3	63rd & State Line	Street	Pick			X		X	X	X	X		\$3,150
17-4	63rd Street	Street	Pick			X		X	X	X	X		\$2,150
27-5	State Line Road and 63rd Street	Street	Vented	X		X		X	X	X			\$2,800
3-3new	At bend from 1-14 to 3-4	RECOMMENDED										X	\$3,500
6-21new	Middle of line 6-22 to 6-10 (~300 ft from either end)	RECOMMENDED										X	\$3,500
2-1A new ⁽²⁾	US end of 12 o'clock line in manhole 2-1.	UNKNOWN											
Total	35			18	2	18	8	14	21	14	4	4	\$68,300
Notes													
(1) Recommendations based on TV. Additional repair work may be required based on actual inspection.													
(2) Upstream end of line should be located after point repair is complete. If manhole exists, inspect and add recommendations. If manhole does not exist, a new manhole should be installed at upstream location prior to CIPP.													

Appendix B-2
Televised Segments with Rehabilitation Recommendations

Appendix B-2 - Televised Line Segments and Recommendations

Priority	US MH	DS MH	TV Direction	Length TV'd (ft)	Total		Pipe Material	Defects	Method of Repair	Length of Repair (US-DS)	Location of Repair (US-DS)	Repair Cost
					Length (if different)	Dia. (in)						
3	1-1	1-2	Down > Up	133	-	8	VCP	8' Horizontal Crack - 3 30 - 129' Roots - 2 123' Radial Crack - 2 128' Radial Crack - 3	CIPP	133		\$4,921
1	1-2	1-4	Up > Down	215	-	8	VCP	12 - 20' Roots - 3 15' Broken Pipe - 5 60' Scaling - 1 75' Radial Crack - 2 84' Radial Crack - 2 90' Scaling - 2 124' Scaling - 2 137' Radial Crack - 2 182 - 210' Roots - 2 190' Radial Crack - 3	Point and CIPP	10	10-20	\$12,955
2	1-13	3-1	Down > Up	102	-	8	PVC/VCP	58' Bend to Right (slight) 60 - 64' Broken Pipe - 3 77' Broken Pipe - 3 79' Horizontal Crack - 2	CIPP	102		\$3,774
-	1-14	3-4	Up > Down	371	-	8	PVC	318' 90 degree bend left	None	-		\$0
1	Unknown	2-1 ⁽³⁾	N/A	0	Unknown	8	VCP	1' Sag 1' Broken Pipe - 5 (First 12 joints) Roots - 3	Point and CIPP	10	0-10	
2	2-1	2-2	Down > Up	79	-	8	VCP	7 - 19' Sag - 2 46' Broken Pipe - 4 67 - 72' Roots - 2	CIPP	79		\$2,923
2	2-2	LH 2-3	Up > Down	226	-	8	VCP	23' Radial Crack - 4 50 - 60' Sag - 4 212' Radial Crack - 3 226' Radial Crack - 2	Point and CIPP	10	50-60	\$13,362
1	LH 2-3	2-4	Up > Down	278	285	8	PVC/VCP	2' Broken Pipe - 4 16' Offset - 4 (PVC pt. repair) 52' Offset - 4 110' Horizontal Crack - 4 127' Broken Pipe - 3 184' Horizontal Crack - 3 215' Broken Pipe - 3 270 - 278' Sag - 4	Replace	285		\$35,625

Appendix B-2 - Televised Line Segments and Recommendations

Priority	US MH	DS MH	TV Direction	Length TV'd (ft)	Total Length (if different)	Dia. (in)	Pipe Material	Defects	Method of Repair	Length of Repair (US-DS)	Location of Repair (DS-US)	Repair Cost
1	2-4	4-1 (LH)	Up > Down	376	-	8	VCP	62' - 75' Sag - 4 212 - 223' Broken Pipe - 4 216 - 220' Infiltration - 1 242' Horizontal Crack - 2 266 - 279' Broken Pipe - 4 304 - 320' - Broken Pipe 4/5 312' Scaling - 2 325 - 337' Broken Pipe - 3 369' Broken Pipe - 3	Replace	376		\$47,000
1	2-5	2-2	Down > Up	62	75	8	VCP	11' Broken Pipe - 5 46' Broken Pipe - 3 50 - 56' Sag - 3 57' Broken Pipe - 4	Replace	75		\$9,375
-	3-1	1-14	Down > Up	27	-	8	PVC		None			\$0
	3-2	3-3	N/A	0	71				None			\$0
	3-3	3-4	N/A	0	25				None			\$0
3	4-1 (LH)	4-2	Down > Up	79	-	8	VCP	20' Missing Pipe - 1 (1" piece) 42' Radial Crack - 2 64' Roots - 2	CIPP	79		\$2,923
2	6-7 (2)	2-4	Up > Down	157	168	8	VCP	38' Infiltration - 4 (1.0 GPM) 62 - 150' Roots - 2 109' Horizontal Crack - 2 150' Sag - 3 152' Broken Pipe - 2	CIPP	168		\$6,216
3	6-7new	6-7	Up > Down	176	-	8	VCP	122 - 146' Roots - 2	CIPP	176		\$6,512
-	6-10	6-10A	Up > Down	7	-	8	VCP		None	-		\$0
3	6-10A	6-11	Up > Down	60	-	8	PVC/VCP	20-57' Roots - 2	CIPP	60		\$2,220
2	6-11	6-7new	Up > Down	118	-	8	PVC/VCP	3 - 34' Roots - 2 82 - 93' Horizontal Crack - 2 108' Broken Pipe - 2	CIPP	118		\$4,366
1	New 6-21 (1)	6-10	Down > Up	600	563	8	PVC/VCP	7 - 86' Roots - 2 178' Missing Pipe - 2 222 - 228' Horizontal Crack - 2 253' Gapped Joint - 4 253' Offset - 4	CIPP	563		\$20,831
-	6-22	New 6-21 (1)	Up > Down	-	-	-	-	3' Bend to Rt. (20 degree) 164 - 170' Roots - 2 222 - 260 - Roots - 1	-	-		-
-	6-23	6-22	Up > Down	140	-	8	PVC/VCP	87 - 111' Roots - 2 135' Bend to Rt. (20 degree)	None	-		\$0
2	9-7	14-1	Up > Down	250	-	8	VCP	104 - 180' Roots - 3 180 - 215' Broken Pipe - 4	Point and CIPP	15	0-15	\$14,750
-	9-7new	9-7	Down > Up	207	-	8	VCP		None	-		\$0

Appendix B-2 - Televised Line Segments and Recommendations

Priority	US MH	DS MH	TV Direction	Length TV'd (ft)	Total		Pipe Material	Defects	Method of Repair	Length of Repair	Location		Repair Cost
					Length (if different)	Dia. (in)					of Repair (US-DS)	Location (DS-US)	
-	9-8	9-7new	Down > Up	29	-	8	VCP	5 - 160' Roots - 2	None	-			\$0
2	14-1	14-2	Up > Down	195	-	8	VCP	57 - 68' Horizontal Crack - 2 100 - 105' Broken Pipe - 3 165 - 190' Broken Pipe 3/4	CIPP	195			\$7,215
2	14-2	14-3	Down > Up	266	280	8	VCP	42 - 77' Roots - 1 117' Broken Pipe - 4 178' Hole In Pipe - 2 255 - 270+ Broken Pipe - 3	CIPP	280			\$10,360
2	14-3	18-5	Up > Down	230	-	8	VCP	10 - 82' Roots - 3 84 - 95' Deposits - 1 162 - 168' Horizontal Crack - 3 204 - 213' Broken Pipe - 3	CIPP	230			\$8,510
1	17-1	17-2	Down > Up	162	370	8	VCP	36 - 43' Broken Pipe - 4 44 - 50' Roots - 2 52 - 76' Broken Pipe - 4 95' Broken Pipe - 4 141' Broken Pipe - 4 162' Roots - 5	CIPP	370			\$13,690
2	17-2	17-3	Down > Up	315		12	VCP	209 - 235' Broken Pipe - 3 249' Broken Pipe - 3 281' - Horizontal Crack - 3	CIPP	315			\$14,805
2	17-3	17-4	Up > Down	140	-	12	VCP	296 - 307' Scaling - 3 62 - 72' Broken Pipe - 3 69' Scaling - 2	CIPP	140			\$6,580
-	17-4	17-5	Up > Down	215	-	12	VCP	155' Roots - 2 204' Sealing - 3	None	-			\$0
3	27-5	27-4	Up > Down	315	-	12	VCP	46' Horizontal Crack - 4	CIPP	315			\$14,805
-	27-11	KCMO	N/A	0	Unknown				None	-			\$0
Totals													
										CIPP Rehabilitation \$163,618			
										Point Repair Rehabilitation \$20,500			
										Replace Entire Line Segment \$92,000			
										Estimated Construction Total \$276,118			

Appendix C
Public Smoke and Dyed-Water Testing Summary for
Storm System Connections Recommended for Additional Investigations

Upstream Manhole	Downstream Manhole	Length (ft)	Dye w/ Concurrent TV	Dye w/ Traffic Control	Dye w/ Additional Water Source	Post Rehab Smoke Testing	Television Inspection	Other	Recommendation
1-14	3-4	370					X	X	Verify line segments 1-14 to 3-2, 3-2 to 3-3, and 3-3 to 3-4 are no longer active. Once confirmed, disconnect the line from the existing sewer system. If services are active, manhole and tv inspections should be completed and repairs made.
1-14	3-2	270					X	X	Verify no active services exist. Fill w/ flowable fill to prevent infiltration from entering system.
2-1(a)	2-1	200					X		After point repair. Verify manhole exists at upstream location and no additional defects exist which may require repair prior to CIPP.
2-1	2-2	79	X						No repair recommended until inflow source is identified.
2-3	2-4	285	X						Prior to replacement.
3-2	3-3	75					X	X	Verify no active services exist. Fill w/ flowable fill to prevent infiltration from entering system.
3-3	3-4	25					X	X	Verify no active services exist. Fill w/ flowable fill to prevent infiltration from entering system.
6-10A	6-11	60							Segment is recommended for CIPP. No additional testing is required since heavy flow thru the pipe did not result in a positive dye test.
6-22	6-10	563			X				After CIPP
9-8	9-7	236	X					X	No pipe repair recommended until inflow source is identified. Complete manhole rehab. Contact the City of Mission Hills in regard to the storm line associated with the basin on Drury Ln.
14-2	14-3	280				X			After CIPP
14-3	18-5		X						Prior to CIPP.
17-1	17-2			X	X				Dyed water test with additional water source and traffic control. Complete tv inspection after removal of root blockage and before CIPP.
17-3	17-4				X				Prior to CIPP.
27-5	27-4			X	X				Prior to CIPP.
Totals			4	2	3	2	5	5	

Appendix C

Public Smoke and Dyed-Water Testing Summary for Storm System Connections Recommended for Additional Investigations



Line Segment and Location

The line segment 14-3 to 18-5 is located along Brookwood Rd. flowing to the southwest to Mission Dr.

Smoke Testing Results

Smoke was identified leaking from a hole in the centerline of 4 foot by 6 foot stone ditch. The ditch provides runoff for the upstream catch basins located at the intersection of Brookwood Rd and State Line and runoff from Brookwood Rd.

Dyed-Water Flooding Results

Dyed-water flooding was performed utilizing a fire hydrant and two lengths of fire hose. A steady flow of water was fed directly into the ditch. A steady drip from a dye bucket just upstream of the defect colored the water. After approximately 20 minutes, a light concentration of dye was observed at the downstream manhole 18-5 from the north incoming line. Although only light dye was observed, the results of the dye test did not reflect actual wet weather conditions. Higher amounts of I/I would be expected during a rainfall event when the ditch is flowing full.

Television Inspection Results

The segment has roots at most joints towards the upstream end. There are two wye connections located on the right side of the pipe in close proximity to where the smoke was observed. Broken pipe was observed towards the downstream end.

Recommendations

It is recommended that this line be televised with concurrent dyed-water testing to identify the specific source of inflow. This line is also recommended for CIPP after dyed-water testing.

SMOKE TEST FORM

Client name: JCW - Mission Hills

Project No. 10496

1. UPSTREAM MANHOLE: 14-3

DOWNSTREAM MANHOLE: 18-5

2. DATE: 9, 10, 04

INSPECTION CREW: RC, RB, JR

RESULTS: (POS) SUS / NEG / CANNOT TEST

OBS#	SOURCE ADDRESS/LOCATION (ALL POSITIVE AND SUSPECT)	RESULT	STATUS	SOURCE TYPE	SMOKE	AREA	RUN OFF	TV Y/N	ROLL/ PHOTO#
1	SMOKE @ STORM DITCH FLOW LINE	1	1	12	3	10 70	4	Y	9127, 28
2	SMOKE AROUND FLOOD GATE FROM MH 18-5	1	2	18	3		1	N	9130
3									
4									
5									
6									
7									
8									
9									
10									

RESULT CODES

1. POSITIVE
2. SUSPECT
3. NEGATIVE
4. CANNOT TEST

STATUS CODES

1. PRIVATE
2. PUBLIC

SOURCE TYPE CODES

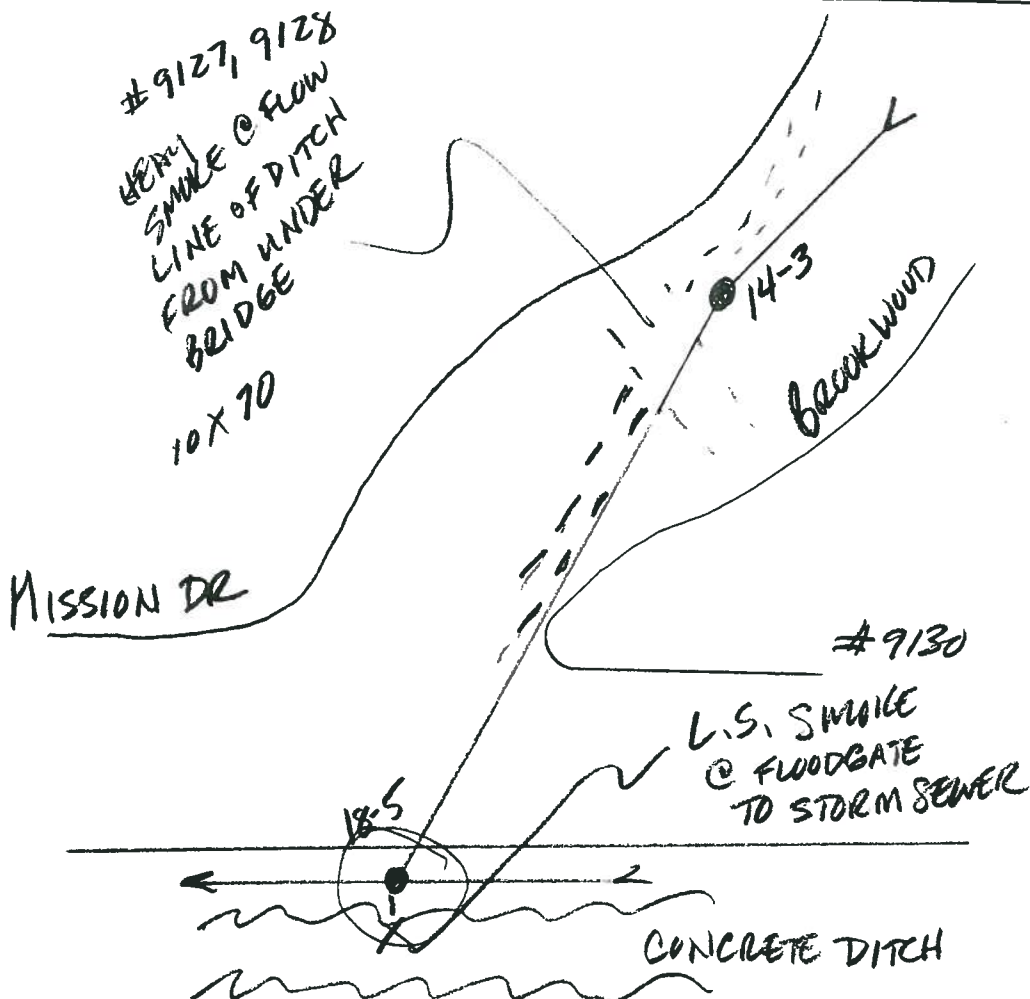
1. SERVICE LATERALS
2. TRANSITION JOINT
3. DRIVEWAY DRAIN
4. WINDOW WELL DRAIN
5. STAIRWELL DRAIN
6. AREA DRAIN
7. DOWNSPOUT
8. DOWNSPOUT CONNECT.
9. FOUNDATION DRAIN
10. BUILDING INSIDE
11. CATCH BASIN
12. STORM DITCH
13. STORM MANHOLE
14. MAIN SEWER
15. UPSTREAM MANHOLE
16. CLEANOUT
17. CRAWL SPACE
18. OTHER

SMOKE CODES

1. LIGHT
2. MEDIUM
3. HEAVY

RUNOFF CODES

1. 0% PAVED
2. 25% PAVED
3. 50% PAVED
4. 75% PAVED
5. 100% PAVED



COMMENTS



Line Segment and Location

The line segment 14-2 to 14-3 is located on Brookwood Rd. northeast of Mission Dr.

Smoke Testing Results

This segment had numerous smoke defects including: light smoke from a catch basin located in front of 2101 Brookwood Rd., and medium to heavy smoke from the main sewer at stations 0+36- 0+69, 0+93- 1+12, 1+54- 1+75 and 1+93 measured from the upstream manhole.

Television Inspection Results

Roots and broken pipe were seen throughout.

Recommendations

Segment is recommended for CIPP and then should be retested by smoke testing to verify that the inflow sources have been removed.

SMOKE TEST FORM

Client name: JCW - Mission Hills

Project No. 10496

1. UPSTREAM MANHOLE: 14-4

DOWNSTREAM MANHOLE: 14-3

2. DATE: 9, 10, 04

INSPECTION CREW: RC/RB/JR

RESULTS: POS / SUS / NEG / CANNOT TEST

OBS#	SOURCE ADDRESS/LOCATION (ALL POSITIVE AND SUSPECT)	RESULT	STATUS	SOURCE TYPE	SMOKE	AREA	RUN OFF	TV Y/N	ROLL/ PHOTO#
1	C.B. E. SIDE OF BROOKWOOD RD	1	2	1	1	8	5	Y	9122
2	S.L. @ 2101 BROOKWOOD RD	1	1	1	2	30	50	N	9120, 21
3	S.L. @ 2115 BROOKWOOD RD	1	1	1	1	30	50	N	9117
4	D.D. @ 2115 BROOKWOOD RD	1	1	3	3	50	50	N	9116
5	M.L. 0+93-1+12	1	2	14	2	20	30	Y	9125
6	M.L. - 1+54-1+75	1	2	14	2	20	30	Y	—
7	M.L. - 0+36+0+69	1	2	14	2	70	30	Y	9123, 24
8	M.L. - 1+93	1	2	14	3	10	30	Y	9126
9									
10									

RESULT CODES

1. POSITIVE
2. SUSPECT
3. NEGATIVE
4. CANNOT TEST

STATUS CODES

1. PRIVATE
2. PUBLIC

SOURCE TYPE CODES

1. SERVICE LATERALS
2. TRANSITION JOINT
3. DRIVEWAY DRAIN
4. WINDOW WELL DRAIN
5. STAIRWELL DRAIN
6. AREA DRAIN
7. DOWNSPOUT
8. DOWNSPOUT CONNECT.
9. FOUNDATION DRAIN
10. BUILDING INSIDE
11. CATCH BASIN
12. STORM DITCH
13. STORM MANHOLE
14. MAIN SEWER
15. UPSTREAM MANHOLE
16. CLEANOUT
17. CRAWL SPACE
18. OTHER

SMOKE CODES

1. LIGHT
2. MEDIUM
3. HEAVY

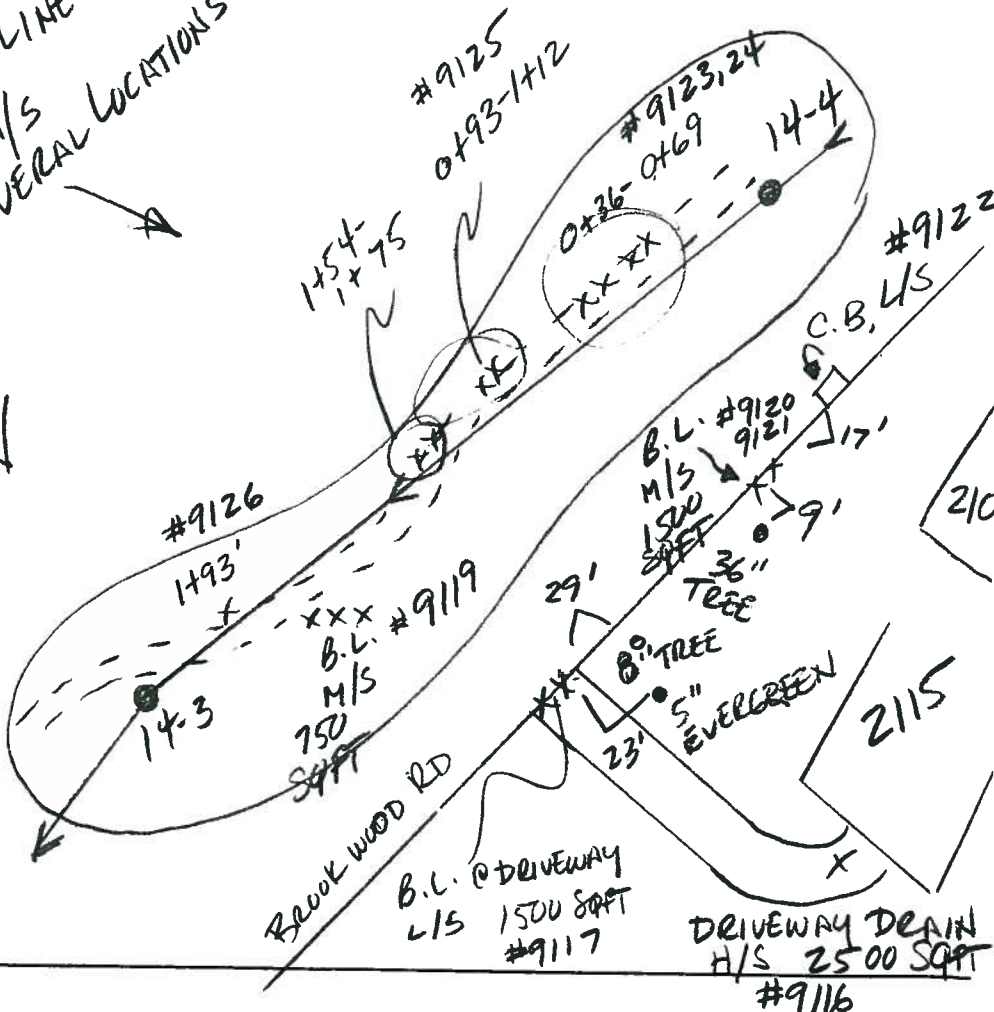
RUNOFF CODES

1. 0% PAVED
2. 25% PAVED
3. 50% PAVED
4. 75% PAVED
5. 100% PAVED

COMMENTS

MAIN LINE
M-H/S
SEVERAL LOCATIONS

N





Line Segment and Location

The line segment 9-8 to 9-7 is located on Brookwood Rd. southwest of Drury Ln.

Smoke Testing Results

Heavy smoke was observed coming from a catch basin located on Drury Ln. near the intersection of Brookwood Rd. Heavy smoke was also observed at a storm manhole and adjacent storm lines exiting into the storm ditch downstream of manhole 9-7. A catch basin located at the median just upstream of manhole 9-7 was observed to have heavy smoke during smoke testing. The storm line exiting this catch basin is connected to the storm line previously tested.

Dyed-Water Flooding Results

The two parallel storm lines that drain into the storm ditch were dyed-water flooded and the tests were negative. The catch basin located on Drury Ln. was dyed-water flooded utilizing water from a fire hydrant located on the opposite side of the street. The storm line located in the storm manhole just downstream of manhole 9-7 was plugged. Heavy concentrations of dyed-water were observed at manhole 9-7 from the northwest incoming line, the lower portion of the manhole walls, and voids around the northwest incoming and southwest outgoing pipe seals. The inflow coming from the northwest incoming pipe seal was estimated to be 30-40 gpm while the inflow from the outgoing pipe seal was estimated to around 10 gpm. The dyed-water test of the catch basin upstream of manhole 9-7 at the median was negative.

Television Inspection Results

This sanitary sewer line appears to be in above average condition. Observations include numerous service connections and a few minor offsets.

Recommendations

It is recommended that line segment 9-8 to 9-7 be televised with concurrent dyed-water flooding to locate the specific source of inflow. No rehabilitation is recommended for this line at this time. Manhole 9-7 is recommended for rehabilitation of the wall and bench. Pipe seals should also be addressed during construction. Also, it is recommended to contact the City of Mission Hills to repair the storm line associated with the catch basin on Drury Ln.

SMOKE TEST FORM

Client name: JCW - Mission Hills

Project No. 10496

1. UPSTREAM MANHOLE: 9-8

DOWNSTREAM MANHOLE: 9-7

2. DATE: 9, 10, 04

INSPECTION CREW: RC/RB/JR

RESULTS: (POS) SUS / NEG / CANNOT TES

OBS#	SOURCE ADDRESS/LOCATION (ALL POSITIVE AND SUSPECT)	RESULT	STATUS	SOURCE TYPE	SMOKE	AREA	RUN OFF	TV Y/N	ROLL/ PHOTO#
1	C.B. @ DEURY LN	1	2	11	2	8 400	3	Y	9115
2	C.B. @ BROOKWOOD RD	1	2	11	2	16 200	4	Y	9107
3									
4									
5									
6									
7									
8									
9									
10									

RESULT CODES

1. POSITIVE
2. SUSPECT
3. NEGATIVE
4. CANNOT TEST

STATUS CODES

1. PRIVATE
2. PUBLIC

SOURCE TYPE CODES

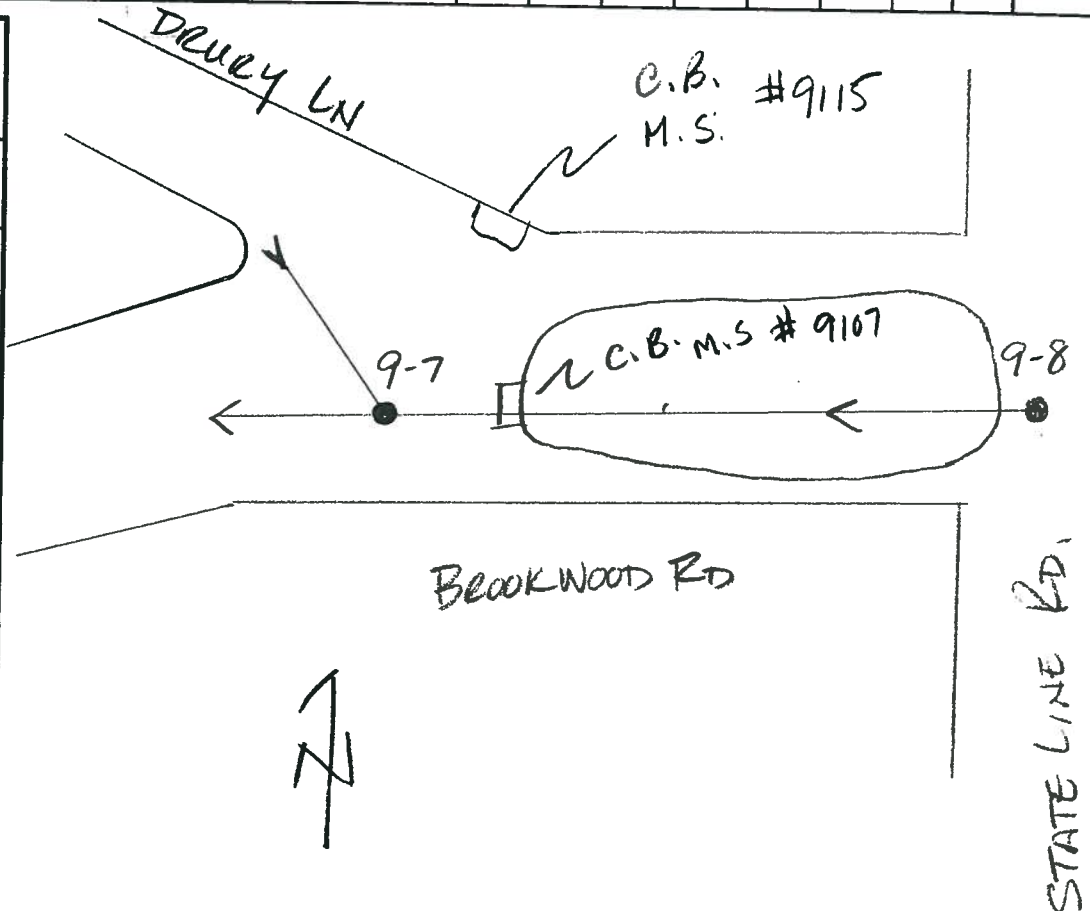
1. SERVICE LATERALS
2. TRANSITION JOINT
3. DRIVEWAY DRAIN
4. WINDOW WELL DRAIN
5. STAIRWELL DRAIN
6. AREA DRAIN
7. DOWNSPOUT
8. DOWNSPOUT CONNECT.
9. FOUNDATION DRAIN
10. BUILDING INSIDE
11. CATCH BASIN
12. STORM DITCH
13. STORM MANHOLE
14. MAIN SEWER
15. UPSTREAM MANHOLE
16. CLEANOUT
17. CRAWL SPACE
18. OTHER

SMOKE CODES

1. LIGHT
2. MEDIUM
3. HEAVY

RUNOFF CODES

1. 0% PAVED
2. 25% PAVED
3. 50% PAVED
4. 75% PAVED
5. 100% PAVED



COMMENTS

SMOKE TEST FORM

Client name: JCW – Mission Hills

Project No. 10496

1. UPSTREAM MANHOLE: 9-7

DOWNSTREAM MANHOLE: 14-1

2. DATE: 9, 10, 04

INSPECTION CREW: RC/RB/JR

RESULTS: POS / SUS / NEG / CANNOT TES

[illegible]

RESULT CODES

1. POSITIVE
2. SUSPECT
3. NEGATIVE
4. CANNOT TEST

STATUS CODES

1. PRIVATE
2. PUBLIC

SOURCE TYPE CODES

1. SERVICE LATERALS
2. TRANSITION JOINT
3. DRIVEWAY DRAIN
4. WINDOW WELL DRAIN
5. STAIRWELL DRAIN
6. AREA DRAIN
7. DOWNSPOUT
8. DOWNSPOUT CONNECT.
9. FOUNDATION DRAIN
10. BUILDING INSIDE
11. CATCH BASIN
12. STORM DITCH
13. STORM MANHOLE
14. MAIN SEWER
15. UPSTREAM MANHOLE
16. CLEANOUT
17. CRAWL SPACE
18. OTHER

SMOKE CODES

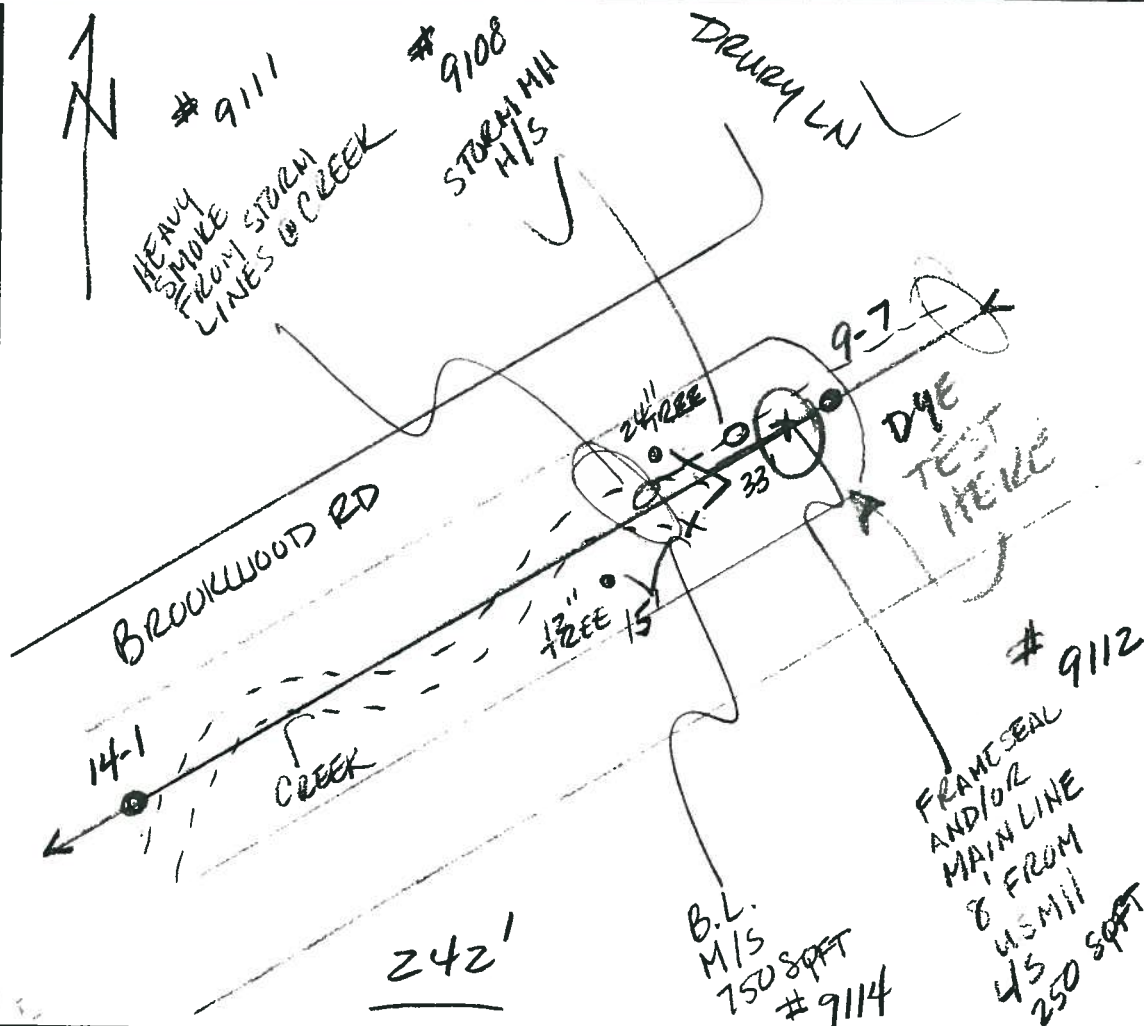
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|----|--------|
| 1. | LIGHT |
| 2. | MEDIUM |
| 3. | HEAVY |

RUNOFF CODES

1. 0% PAVED
2. 25% PAVED
3. 50% PAVED
4. 75% PAVED
5. 100% PAVED

COMMENTS

? ? 9109, 9110, 9113





Line Segment and Location

The line segment 6-10A to 6-11 is located on Pembroke Ln. running northwesterly towards W. 56th St.

Smoke Testing Results

Medium smoke was observed coming from the catch basin located in front of 5625 Pembroke Ln.

Dyed-Water Flooding Results

The catch basin was dyed-water flooded utilizing the nearby fire hydrant and a steady drip from a dye bucket located at the catch basin. The storm line exits the catch basin on Pembroke Ln., crosses over the sanitary sewer, and discharges at a nearby storm ditch. The storm line was plugged at the discharge but the dyed-water was only partially restricted because the storm line is out of round. This section of storm sewer has been previously rehabilitated by lining it with a PVC pipe. There is a void between the existing concrete pipe and the new PVC liner. It is thought that the smoke migrated through this void as it exited from the sanitary sewer. The dye test was negative with a minimal amount of dyed-water backed up into the storm line.

Television Inspection Results

There are several observations of roots throughout this segment.

Recommendations

This segment is recommended for CIPP. No additional testing is recommended.

SMOKE TEST FORM

Client name: JCW - Mission Hills

Project No. 10496

1. UPSTREAM MANHOLE: 6-10A

DOWNSTREAM MANHOLE: 6-11

2. DATE: 9, 9, 04

INSPECTION CREW: RC/RB/JR

RESULTS: POS / SUS / NEG / CANNOT TES

OBS#	SOURCE ADDRESS/LOCATION (ALL POSITIVE AND SUSPECT)	RESULT	STATUS	SOURCE TYPE	SMOKE	AREA	RUN OFF	TV Y/N	ROLL/ PHOTO#
1	C.B. @ PEMBROKE LN	1	1	11	1	10	250	4	Y 9102
2									
3									
4									
5									
6									
7									
8									
9									
10									

RESULT CODES

1. POSITIVE
2. SUSPECT
3. NEGATIVE
4. CANNOT TEST

STATUS CODES

1. PRIVATE
2. PUBLIC

SOURCE TYPE CODES

1. SERVICE LATERALS
2. TRANSITION JOINT
3. DRIVEWAY DRAIN
4. WINDOW WELL DRAIN
5. STAIRWELL DRAIN
6. AREA DRAIN
7. DOWNSPOUT
8. DOWNSPOUT CONNECT.
9. FOUNDATION DRAIN
10. BUILDING INSIDE
11. CATCH BASIN
12. STORM DITCH
13. STORM MANHOLE
14. MAIN SEWER
15. UPSTREAM MANHOLE
16. CLEANOUT
17. CRAWL SPACE
18. OTHER

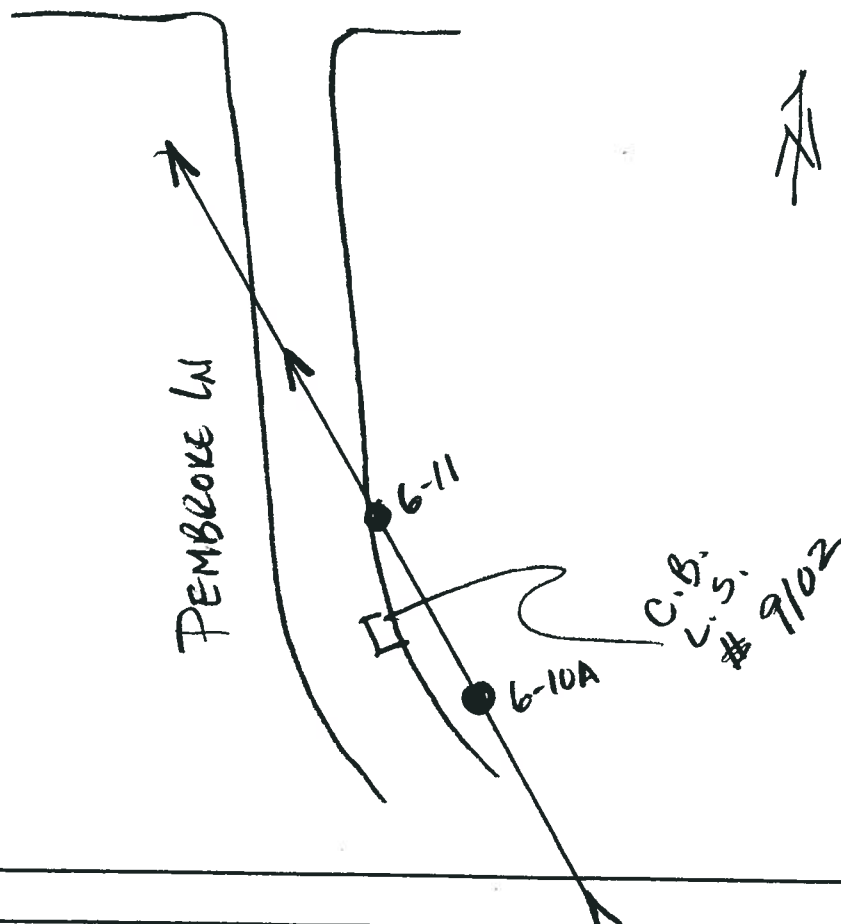
SMOKE CODES

1. LIGHT
2. MEDIUM
3. HEAVY

RUNOFF CODES

1. 0% PAVED
2. 25% PAVED
3. 50% PAVED
4. 75% PAVED
5. 100% PAVED

W. 56th ST



COMMENTS



Line Segment and Location

The line segment 6-22 to 6-10 (with LH 6-21 mapped between) is located near State Line running northwest towards Pembroke Ln.

Smoke Testing Results

Smoke was observed coming from the 3' culvert flowing to the northeast. Smoke was also observed coming from the 24" storm discharge into the storm ditch just downstream of the box culvert. This storm line flows from a catch basin located in front of 5740 State Line Rd.

Dyed-Water Flooding Results

The 24" storm line was plugged at the discharge to the storm ditch. The catch basin was flooded utilizing the dyed-water trailer. There was no access to a fire hydrant for a more significant water source for this location. A light trace of dye was observed at manhole 6-10. The storm culvert was inaccessible for dye testing as a result of standing water in the culvert.

Television Inspection Results

Roots were observed at most joints as well as a few segments with horizontal cracks.

Recommendations

Segment is recommended for CIPP and then should be retested by smoke testing to verify that the inflow sources have been removed.

SMOKE TEST FORM

Client name: JCW - Mission Hills

Project No. 10496

1. UPSTREAM MANHOLE: 6-22

DOWNSTREAM MANHOLE: 6-21

2. DATE: 9, 10, 04

INSPECTION CREW: RC/RB/JR

RESULTS: POS SUS / NEG / CANNOT TES

OBS#	SOURCE ADDRESS/LOCATION (ALL POSITIVE AND SUSPECT)	RESULT	STATUS	SOURCE TYPE	SMOKE	AREA	RUN OFF	TV Y/N	ROLL PHOTO#
1	5740 PEMBROKE DR - BL	1	1	1	3	10 20	1	N	9095
2	21" STORM LINE	1	2	12	3		3	Y	9098
3	STORM DITCH	1	2	12	3	16 100	3	Y	9096,9
4									
5									
6									
7									
8									
9									
10									

RESULT CODES

1. POSITIVE
2. SUSPECT
3. NEGATIVE
4. CANNOT TEST

STATUS CODES

1. PRIVATE
2. PUBLIC

SOURCE TYPE CODES

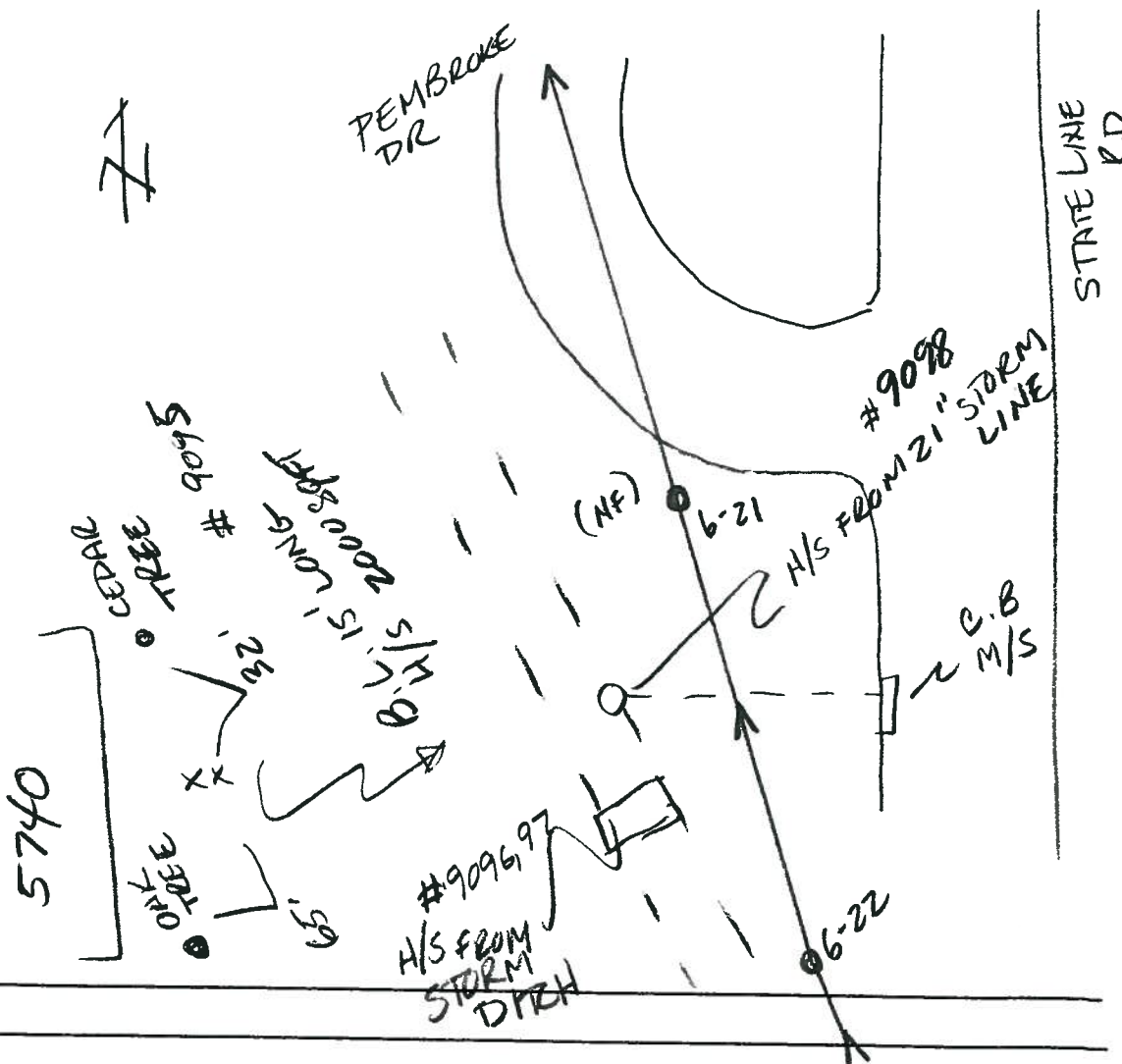
1. SERVICE LATERALS
2. TRANSITION JOINT
3. DRIVEWAY DRAIN
4. WINDOW WELL DRAIN
5. STAIRWELL DRAIN
6. AREA DRAIN
7. DOWNSPOUT
8. DOWNSPOUT CONNECT.
9. FOUNDATION DRAIN
10. BUILDING INSIDE
11. CATCH BASIN
12. STORM DITCH
13. STORM MANHOLE
14. MAIN SEWER
15. UPSTREAM MANHOLE
16. CLEANOUT
17. CRAWL SPACE
18. OTHER

SMOKE CODES

1. LIGHT
2. MEDIUM
3. HEAVY

RUNOFF CODES

1. 0% PAVED
2. 25% PAVED
3. 50% PAVED
4. 75% PAVED
5. 100% PAVED



COMMENTS



Line Segment and Location

The original line segment 1-14 to 3-4 is located on 55th St. at High Dr, running to the northwest towards Mission Dr.

Smoke Testing Results

Light smoke was observed coming from the catch basin on the south side of 55th St.

Dyed-Water Flooding Results

The dyed-water trailer was utilized to flood the storm line exiting the catch basin to the northwest to a storm manhole on 55th St. A plug was installed in the storm line at the storm manhole. A light concentration of dye was observed at manhole 3-3. The manhole 3-2 is inaccessible. It appears that a rock wall has been built to hide the manhole. The line segment 1-14 to 3-2 has been rerouted with a new PVC pipe, around manhole 3-2 and 3-3 then ties into manhole 3-4. There is no evidence of sewage flowing through manhole 3-3 but it did smoke and is still connected to manhole 3-14 and is a source of I/I.

Recommendations

Additional testing is recommended to determine if any service connections along the original segments 1-14 to 3-2 to 3-3 to 3-4 are still active. If no active services still exist, it is recommended to disconnect the line from 3-14 to eliminate the source of inflow and abandoned manholes 3-2 and 3-3. If active services are found to exist along the original lines, then the pipe sections listed above for additional investigations and their corresponding manholes will need to be inspected and necessary repairs made.

SMOKE TEST FORM

Client name: JCW - Mission Hills

Project No. 10496

1. UPSTREAM MANHOLE: 3-1'

DOWNSTREAM MANHOLE: 1-14

2. DATE: 9.9.04

INSPECTION CREW: RC/RB/BR

RESULTS: POS / SUS / NEG / CANNOT TEST

OBS#	SOURCE ADDRESS/LOCATION (ALL POSITIVE AND SUSPECT)	RESULT	STATUS	SOURCE TYPE	SMOKE	AREA	RUN OFF	TV Y/N	ROLL/ PHOTO#
1	C.B. @ HIGH DR	1	2	11	1	16	120	4	Y
* 2	B.L. @	1	2	1	1				
3									
4									
5									
6									
7									
8									
9									
10									

RESULT CODES

1. POSITIVE
2. SUSPECT
3. NEGATIVE
4. CANNOT TEST

STATUS CODES

1. PRIVATE
2. PUBLIC

SOURCE TYPE CODES

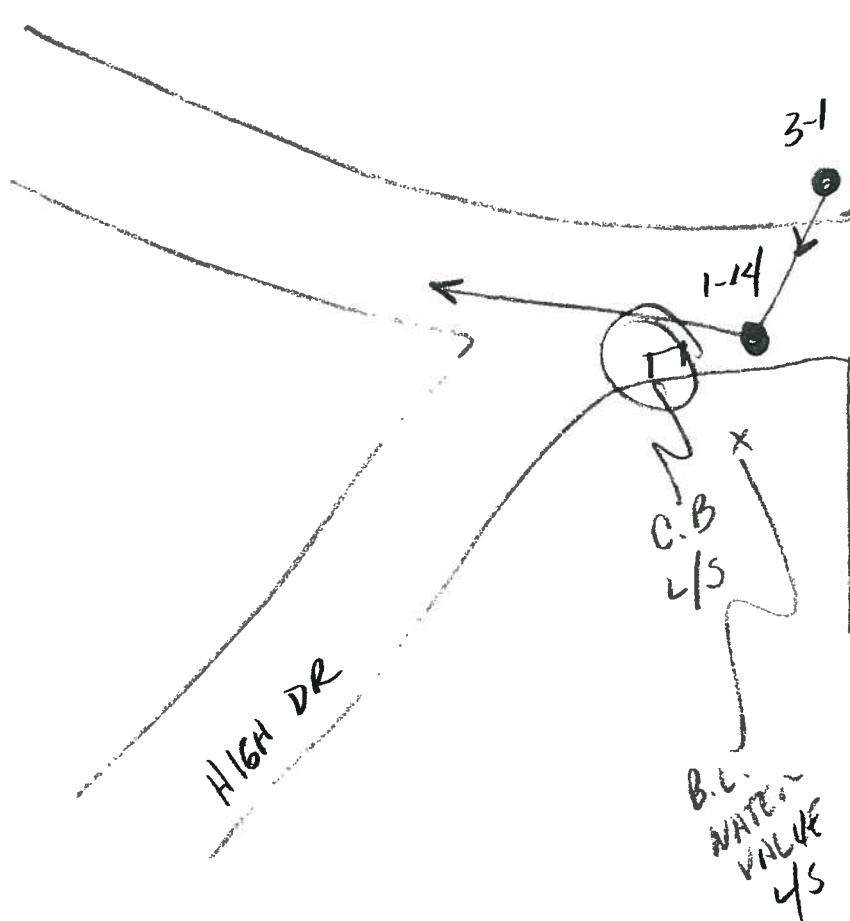
1. SERVICE LATERALS
2. TRANSITION JOINT
3. DRIVEWAY DRAIN
4. WINDOW WELL DRAIN
5. STAIRWELL DRAIN
6. AREA DRAIN
7. DOWNSPOUT
8. DOWNSPOUT CONNECT.
9. FOUNDATION DRAIN
10. BUILDING INSIDE
11. CATCH BASIN
12. STORM DITCH
13. STORM MANHOLE
14. MAIN SEWER
15. UPSTREAM MANHOLE
16. CLEANOUT
17. CRAWL SPACE
18. OTHER

SMOKE CODES

1. LIGHT
2. MEDIUM
3. HEAVY

RUNOFF CODES

1. 0% PAVED
2. 25% PAVED
3. 50% PAVED
4. 75% PAVED
5. 100% PAVED



COMMENTS



Line Segment and Location

The line segment 2-1 to 2-2 is located along State Line Rd running to the southwest towards W. 56th St.

Smoke Testing Results

Heavy smoke was observed coming from a catch basin on the northwest side of State Line at W. 56th St.

Dyed-Water Flooding Results

The dyed-water trailer was utilized to flood the storm line running to the southwest towards W. 56th St. The storm line crosses the sanitary sewer and has to be indirectly connected since there are no services along the line. There was no structure available to plug the storm line downstream of the catch basin. Heavy concentrations of dyed-water were observed entering from the northeast incoming line at manhole 2-2.

Television Inspection Results

This is a short segment with no service connections seen from television inspection. This line is recommended for CIPP for roots and broken pipe.

Recommendations

It is recommended that this line segment be televised with concurrent dyed-water flooding to determine the specific location of the inflow source.

SMOKE TEST FORM

Client name: JCW - Mission Hills

Project No. 10496

1. UPSTREAM MANHOLE: 2-1 DOWNSTREAM MANHOLE: 2-2

2. DATE: 9, 9, 04 INSPECTION CREW: RC/RB/JR RESULTS: POS / SUS / NEG / CANNOT TEST

OBS#	SOURCE ADDRESS/LOCATION (ALL POSITIVE AND SUSPECT)	RESULT	STATUS	SOURCE TYPE	SMOKE	AREA	RUN OFF	TV Y/N	ROLL/ PHOTO#
1	C.B. @ STATE LINE RD	1	2	11	1		4	Y	9083
2									
3									
4									
5									
6									
7									
8									
9									
10									

RESULT CODES

1. POSITIVE
2. SUSPECT
3. NEGATIVE
4. CANNOT TEST

STATUS CODES

1. PRIVATE
2. PUBLIC

SOURCE TYPE CODES

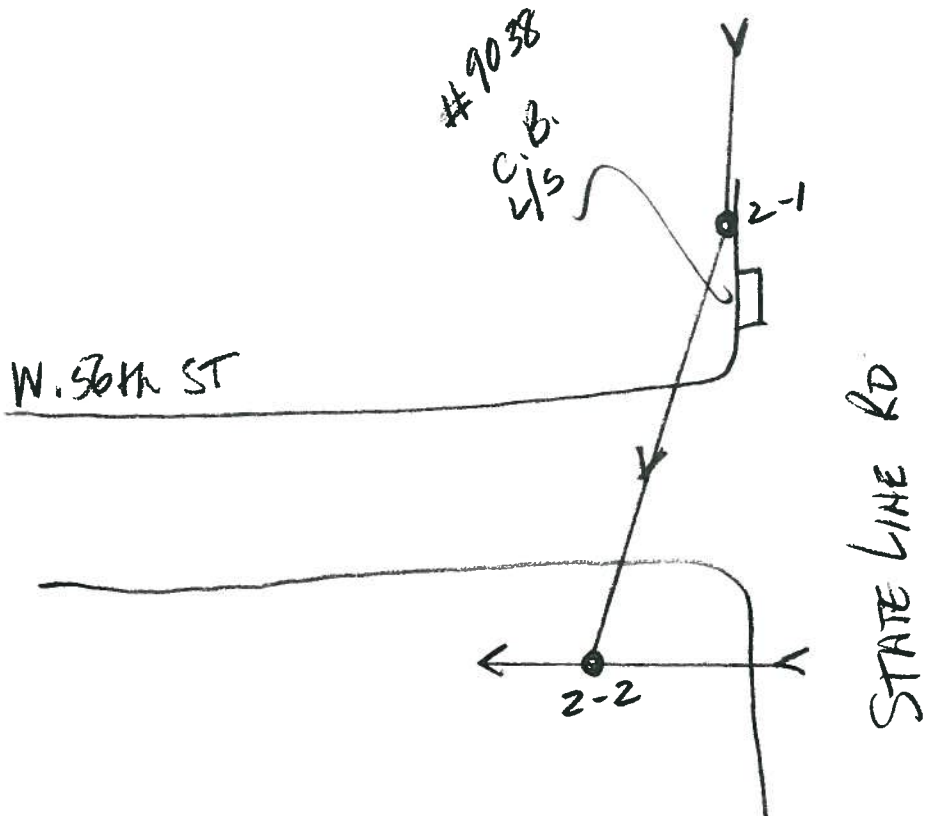
1. SERVICE LATERALS
2. TRANSITION JOINT
3. DRIVEWAY DRAIN
4. WINDOW WELL DRAIN
5. STAIRWELL DRAIN
6. AREA DRAIN
7. DOWNSPOUT
8. DOWNSPOUT CONNECT.
9. FOUNDATION DRAIN
10. BUILDING INSIDE
11. CATCH BASIN
12. STORM DITCH
13. STORM MANHOLE
14. MAIN SEWER
15. UPSTREAM MANHOLE
16. CLEANOUT
17. CRAWL SPACE
18. OTHER

SMOKE CODES

1. LIGHT
2. MEDIUM
3. HEAVY

RUNOFF CODES

1. 0% PAVED
2. 25% PAVED
3. 50% PAVED
4. 75% PAVED
5. 100% PAVED



COMMENTS



Line Segment and Location

The line segment 2-3 to 2-4 is located on W. 56th St. running easterly towards E. Mission Dr.

Smoke Testing Results

Medium smoke was observed at the surface along the main sewer from 1 +13' to 1+30' measured from downstream manhole 2-4.

Dyed-Water Flooding Results

The dyed-water trailer was utilized to flood the main sewer area. Heavy concentrations of dye were observed entering manhole 2-4 through the west incoming line.

Television Inspection Results

This line had many areas of broken pipe, minor to moderate offsets, a severe sag, and a moderate offset where a point repair has begun to settle.

Recommendations

This line is recommended for replacement due to multiple defects that can not be fixed by CIPP. Although the inflow source may be removed by replacing the line, there is also a chance the source is coming from one of the service laterals. It is recommended that this line segment be televised with concurrent dyed-water flooding to determine the specific location of the source of inflow prior to replacement.

SMOKE TEST FORM

Client name: JCW – Mission Hills

Project No. 10496

1. UPSTREAM MANHOLE: 2-3

DOWNSTREAM MANHOLE: 2-4

2. DATE: 9, 9, 04

INSPECTION CREW: RC/RB/JR

RESULTS: POS / SUS / NEG / CANNOT TEST

[illegible]

RESULT CODES

1. POSITIVE
2. SUSPECT
3. NEGATIVE
4. CANNOT TEST

STATUS CODES

1. PRIVATE
2. PUBLIC

SOURCE TYPE CODES

1. SERVICE LATERALS
2. TRANSITION JOINT
3. DRIVEWAY DRAIN
4. WINDOW WELL DRAIN
5. STAIRWELL DRAIN
6. AREA DRAIN
7. DOWNSPOUT
8. DOWNSPOUT CONNECT.
9. FOUNDATION DRAIN
10. BUILDING INSIDE
11. CATCH BASIN
12. STORM DITCH
13. STORM MANHOLE
14. MAIN SEWER
15. UPSTREAM MANHOLE
16. CLEANOUT
17. CRAWL SPACE
18. OTHER

SMOKE CODES

- | | |
|----|--------|
| 1. | LIGHT |
| 2. | MEDIUM |
| 3. | HEAVY |

RUNOFF CODES

1. 0% PAVED
2. 25% PAVED
3. 50% PAVED
4. 75% PAVED
5. 100% PAVED

COMMENTS

Dye Test 10-18-04 Start 1:09 pm End 1:26 pm Result: Positive Photo 9217



Line Segment and Location

Line Segment 17-1 to 17-2 is located along State Line Rd. running south to W. 63rd St.

Smoke Testing Results

Heavy smoke was observed coming from three (3) catch basins on the Missouri Side of State Line Rd. at W. 63rd St.

Dyed-Water Flooding Results

No dyed-water testing was done because of inaccessibility to a fire hydrant on the west side of State Line Rd and heavy traffic along 63rd Street.

Television Inspection Results

The pipe had multiple observations of broken pipe and a few observations of roots, including the joint where the camera was blocked. So far, the condition of the pipe makes it a good candidate for CIPP. A complete television inspection and access to the upstream manhole will be required to complete a CIPP repair.

Recommendations

This segment is recommended for dyed-water testing using the KCMO fire hydrant or other substantial water source along with traffic control along 63rd Street. Also, television inspection past the root blockage will be necessary for final design.

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**Line Segment and Location**

The line segment 17-3 to 17-4 is located on W. 63rd St. running easterly towards Mission Dr.

Smoke Testing Results

Heavy smoke was observed coming from the storm manhole located next to manhole 17-4.

Dyed-Water Flooding Results

No dyed-water testing was done because of inaccessibility to a fire hydrant on the west side of State Line Rd.

Television Inspection Results

Some broken pipe and minor offsets were observed. The line is recommended for CIPP.

Manhole Inspection Results

According to the manhole inspection completed by The Larkin Group, manhole 17-4 had frame seal, cone, bench, and trough defects.

Recommendations

This segment is recommended for dyed-water testing using the KCMO fire hydrant or other substantial water source.

SMOKE TEST FORM

Client name: JCW - Mission Hills

Project No. 10496

1. UPSTREAM MANHOLE: 17-3

DOWNSTREAM MANHOLE: 17-4

2. DATE: 9, 10, 04

INSPECTION CREW: RC/RB/JR

RESULTS: (POS) SUS / NEG / CANNOT TEST

OBS#	SOURCE ADDRESS/LOCATION (ALL POSITIVE AND SUSPECT)	RESULT	STATUS	SOURCE TYPE	SMOKE	AREA	RUN OFF	TV Y/N	ROLL/ PHOTO#
1	STORM MANHOLE @ 63RD ST	1	2	13	3		5	Y	9/36
2									
3									
4									
5									
6									
7									
8									
9									
10									

RESULT CODES

1. POSITIVE
2. SUSPECT
3. NEGATIVE
4. CANNOT TEST

STATUS CODES

1. PRIVATE
2. PUBLIC

SOURCE TYPE CODES

1. SERVICE LATERALS
2. TRANSITION JOINT
3. DRIVEWAY DRAIN
4. WINDOW WELL DRAIN
5. STAIRWELL DRAIN
6. AREA DRAIN
7. DOWNSPOUT
8. DOWNSPOUT CONNECT.
9. FOUNDATION DRAIN
10. BUILDING INSIDE
11. CATCH BASIN
12. STORM DITCH
13. STORM MANHOLE
14. MAIN SEWER
15. UPSTREAM MANHOLE
16. CLEANOUT
17. CRAWL SPACE
18. OTHER

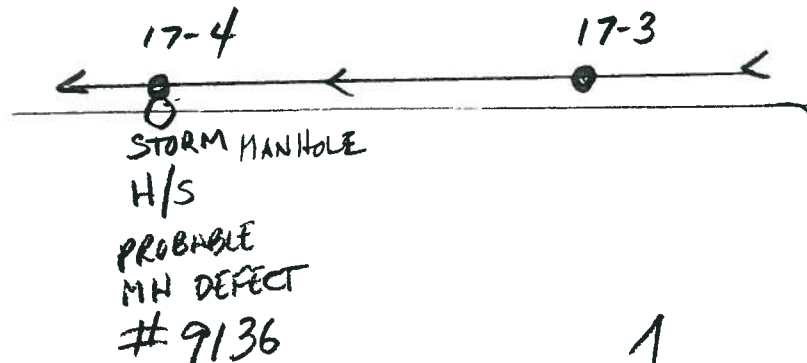
SMOKE CODES

1. LIGHT
2. MEDIUM
3. HEAVY

RUNOFF CODES

1. 0% PAVED
2. 25% PAVED
3. 50% PAVED
4. 75% PAVED
5. 100% PAVED

W. 63RD ST



COMMENTS

**Line Segment and Location**

The line segment 17-4 to 17-5 is located on W. 63rd St. running west to Mission Dr.

Smoke Testing Results

Medium smoke was observed coming from the catch basin located on the north side of W. 63rd Street just east of Mission Dr.

Dyed-Water Flooding Results

The catch basin was flooded utilizing a nearby fire hydrant. A plug was installed at the storm line outlet to the creek. Due to leaks in and around the storm line, water was not backed up in the storm line to the point where it crosses the sanitary sewer. No dye was observed at the downstream manhole as a result of free flowing dyed-water through the storm line. Since a significant source of water was available and the dye result was negative, no further dye testing is recommended.

Television Inspection Results

This pipe appears to be in good condition. The only defect observed was a light root at one joint.

Recommendations

No further recommendations at this time.

SMOKE TEST FORM

Client name: JCW - Mission Hills

Project No. 10496

1. UPSTREAM MANHOLE: 17-4

DOWNSTREAM MANHOLE: 17-5

2. DATE: 9, 10, 04

INSPECTION CREW: RC, RB, JR

RESULTS: (POS) SUS / NEG / CANNOT TEST

OBS#	SOURCE ADDRESS/LOCATION (ALL POSITIVE AND SUSPECT)	RESULT	STATUS	SOURCE TYPE	SMOKE	AREA		RUN OFF	TV Y/N	ROLL/ PHOTO#
1	C.B. ON 63RD ST	1	2	11	2	16	650	5	Y	#9135
2										
3										
4										
5										
6										
7										
8										
9										
10										

RESULT CODES

1. POSITIVE
2. SUSPECT
3. NEGATIVE
4. CANNOT TEST

STATUS CODES

1. PRIVATE
2. PUBLIC

SOURCE TYPE CODES

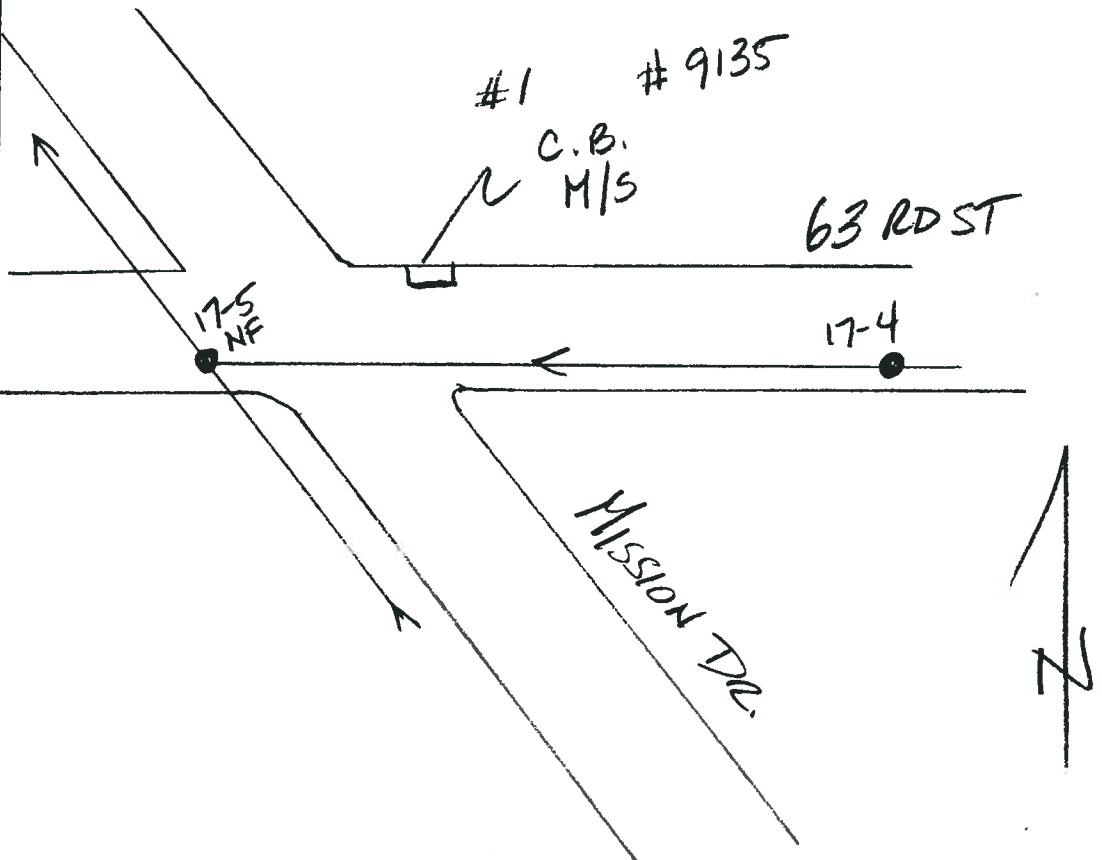
1. SERVICE LATERALS
2. TRANSITION JOINT
3. DRIVEWAY DRAIN
4. WINDOW WELL DRAIN
5. STAIRWELL DRAIN
6. AREA DRAIN
7. DOWNSPOUT
8. DOWNSPOUT CONNECT.
9. FOUNDATION DRAIN
10. BUILDING INSIDE
11. CATCH BASIN
12. STORM DITCH
13. STORM MANHOLE
14. MAIN SEWER
15. UPSTREAM MANHOLE
16. CLEANOUT
17. CRAWL SPACE
18. OTHER

SMOKE CODES

1. LIGHT
2. MEDIUM
3. HEAVY

RUNOFF CODES

1. 0% PAVED
2. 25% PAVED
3. 50% PAVED
4. 75% PAVED
5. 100% PAVED



COMMENTS



Line Segment and Location

The line segment 27-5 to 27-4 is located on Tomahawk Rd. running west towards Mission Dr.

Smoke Testing Results

Heavy smoke was observed coming from a catch basin on the southeast Tomahawk Rd @ State Line Rd. Heavy smoke was also observed coming from a storm manhole west of State Line Rd. along Tomahawk Rd.

Dyed-Water Flooding Results

No dyed-water testing was done because of inaccessibility to a fire hydrant on the west side of State Line Rd and heavy traffic along Tomahawk Road.

Television Inspection Results

This segment is listed as a 12" diameter line, which may explain the dark footage. The only defect requiring repair was a horizontal crack, but CIPP is preferred since other moderate defects may exist which were not visible due to the dark footage.

Additional Investigations

This segment is recommended for dyed-water testing using the KCMO fire hydrant or other substantial water source along with traffic control on Tomahawk Road. The segment is recommended for CIPP after dyed-water testing.

SMOKE TEST FORM

Client name: JCW - Mission Hills

Project No. 10496

1. UPSTREAM MANHOLE: 27-3⁵

DOWNSTREAM MANHOLE: 27-4

2. DATE: 9, 10, 04

INSPECTION CREW: KC, RB, JR

RESULTS: POS SUS / NEG / CANNOT TEST

OBS#	SOURCE ADDRESS/LOCATION (ALL POSITIVE AND SUSPECT)	RESULT	STATUS	SOURCE TYPE	SMOKE	AREA	RUN OFF	TV Y/N	ROLL PHOTO#
1	C.B. @ STATE LINE	1	2	11	3	16 650	5	Y	9131
2	STORM MH ON TOMAHAWK RD	1	2	13	3		5	Y	9132, 33
3	C.B. @ TOMAHAWK	1	2	11	2	16 240	5	Y	9134
4									
5									
6									
7									
8									
9									
10									

RESULT CODES

1. POSITIVE
2. SUSPECT
3. NEGATIVE
4. CANNOT TEST

STATUS CODES

1. PRIVATE
2. PUBLIC

SOURCE TYPE CODES

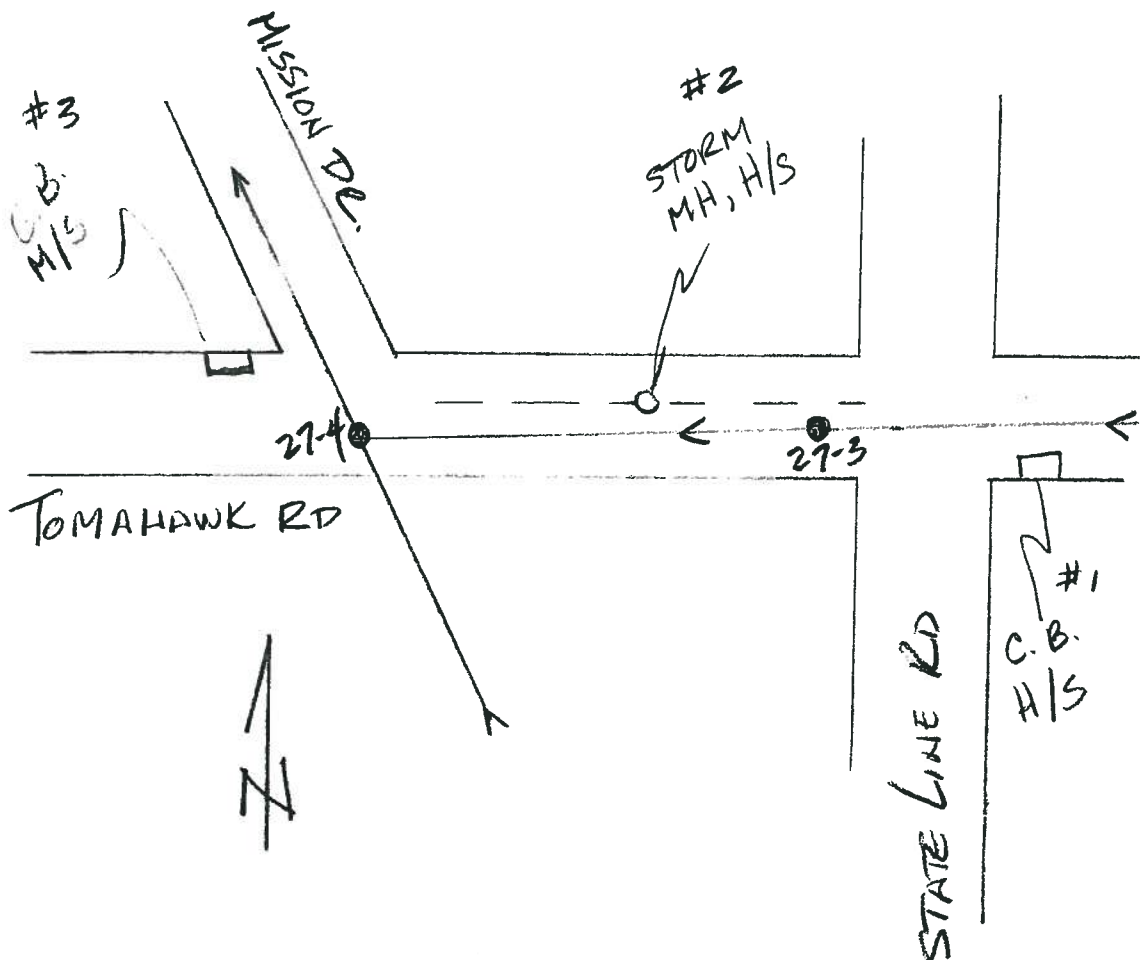
1. SERVICE LATERALS
2. TRANSITION JOINT
3. DRIVEWAY DRAIN
4. WINDOW WELL DRAIN
5. STAIRWELL DRAIN
6. AREA DRAIN
7. DOWNSPOUT
8. DOWNSPOUT CONNECT.
9. FOUNDATION DRAIN
10. BUILDING INSIDE
11. CATCH BASIN
12. STORM DITCH
13. STORM MANHOLE
14. MAIN SEWER
15. UPSTREAM MANHOLE
16. CLEANOUT
17. CRAWL SPACE
18. OTHER

SMOKE CODES

1. LIGHT
2. MEDIUM
3. HEAVY

RUNOFF CODES

1. 0% PAVED
2. 25% PAVED
3. 50% PAVED
4. 75% PAVED
5. 100% PAVED



COMMENTS